CIVIL ENGINEERING

Quebec builds thin-shell-arch hockey stadium in 10 months . . . Robert Zaborowski.

Photo Louis Lanouette

RAYMOND

versus OLD MAN RIVER

Major link in the flood-control system on lower Mississippi River is the 4,200-foot Morganza Floodway Control Structure, 42 miles northwest of Baton Rouge, La. Its 125 bays will have diversion capacity of 600,000 sec.-ft. into spillway at flood stages.

DRIVING 3,700 RAYMOND PRECAST PILES FOR MORGANZA FLOODWAY CONTROL . . .

For the foundations Raymond is casting and driving 3,734 precast reinforced concrete piles, in lengths of 80 to 120 feet. 95 percent are being driven on 2-on-1 batter.

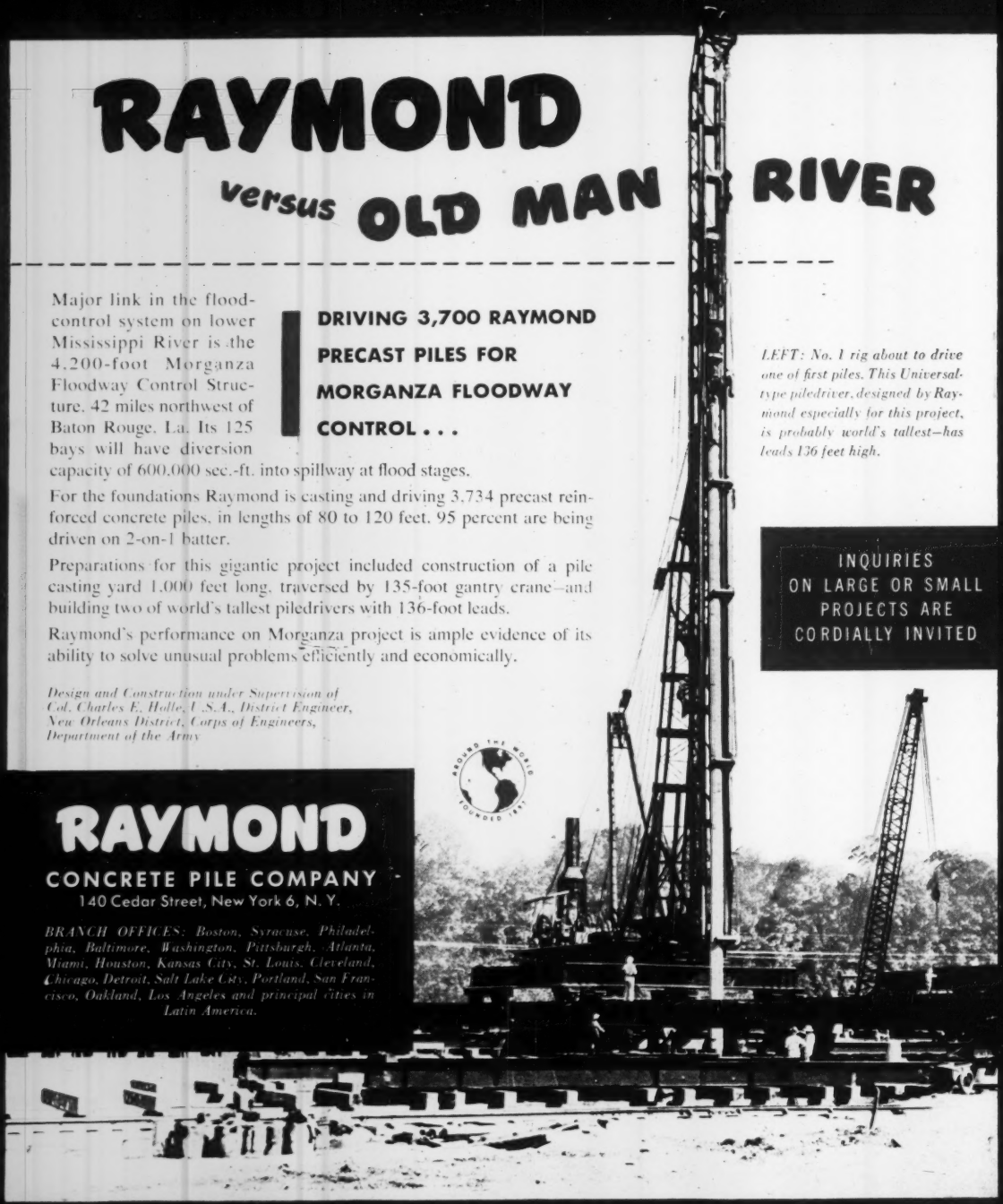
Preparations for this gigantic project included construction of a pile casting yard 1,000 feet long, traversed by 135-foot gantry crane—and building two of world's tallest piledrivers with 136-foot leads.

Raymond's performance on Morganza project is ample evidence of its ability to solve unusual problems efficiently and economically.

Design and Construction under Supervision of Col. Charles E. Holle, U.S.A., District Engineer, New Orleans District, Corps of Engineers, Department of the Army

LEFT: No. 1 rig about to drive one of first piles. This Universal-type piledriver, designed by Raymond especially for this project, is probably world's tallest—has leads 136 feet high.

INQUIRIES ON LARGE OR SMALL PROJECTS ARE CORDIALLY INVITED



RAYMOND

CONCRETE PILE COMPANY

140 Cedar Street, New York 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.

THE SCOPE OF RAYMOND'S ACTIVITIES . . . includes, in addition to borings for soil investigation, every recognized type of foundation construction—concrete, composite, precast, steel, pipe and wood piles. Also caissons, underpinning, construction involving shore protection, shipbuilding facilities, harbor and river improvements, and cement-mortar lining of water, oil and gas pipelines 4" to 144" in diameter by Centriline Corp., a Raymond subsidiary.

New York's City Hall, completed in 1811, as it looked 100 years ago

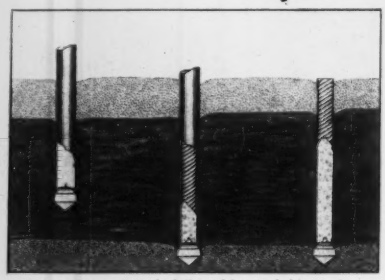
The City of New York has several cast iron water mains in service that were laid more than a century ago. They are part of approximately 5,000 miles of cast iron mains representing about 98% of all the pipe in New York's distribution system. The contrast in traffic and construction, above and underground, today and 100 years ago, is fantastic. Yet the shock-strength, crushing-strength and beam-strength of cast iron mains have enabled them to withstand the unforeseen stresses imposed by vast changes. Because of these strength factors and effective resistance to corrosion, cast iron water and gas mains laid over 100 years ago, are still serving in the streets of 38 cities in the United States and Canada.

United States Pipe and Foundry Company, General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.

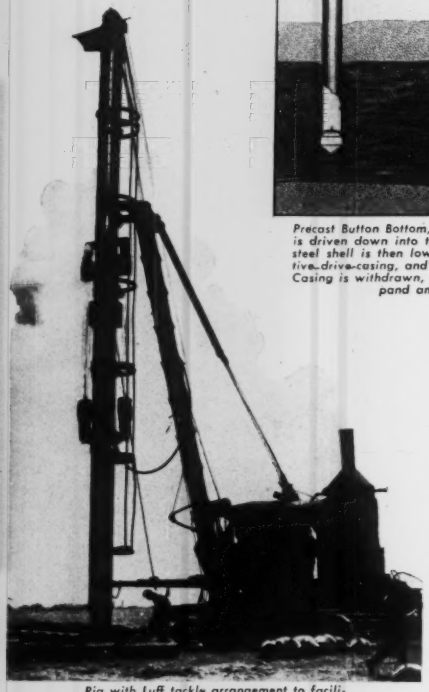
U.S. PIPE

NUMBER TEN OF A SERIES

CIVIL ENGINEERING, The Magazine of Engineered Construction, October, 1951. Vol. 21, No. 10. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.



Precast Button Bottom, followed by steel drive-casing, is driven down into the bearing stratum. Corrugated steel shell is then lowered undamaged inside protective drive-casing, and locked onto the Button Bottom. Casing is withdrawn, allowing compressed soil to expand and grip pile shaft.



Rig with Luff tackle arrangement to facilitate withdrawal of drive-casing, is driving precast Button Bottom and steel casing.

PROJECT: *Foundations for New Buildings at the Philadelphia International Airport*

WESTERN drove 3700 Button Bottom piles through the hard crust of dense rolled sand fill, through the soft layer of peat and mud below it, and placed the entire load in the hard bearing stratum of compacted sand and gravel. Had tapered piles been used, a large part of their driving resistance would have been taken up in the hard fill near the surface, giving a false indication of bearing value. This type of pile would have been subject to ultimate settlement due to consolidation of the intermediate soft layer.

The cylindrical Button Bottom pile gets its full bearing values in the dependable bearing stratum. Frictional bearing values, which accrue after withdrawal of the drive-casing, are an additional safety factor.

The very high pressure in the rolled sand fill made difficult the withdrawal of the drive-casing, after completion of the pile. Western designed an unusually powerful method for withdrawing the drive-casing to overcome this difficulty. By use of a Luff tackle arrangement, it was possible to almost double the 45-ton capacity normally available on rigs of the type used.

DO YOU HAVE A FOUNDATION PROBLEM? Call Western for consultation. A long list of successful solutions to tough foundation problems assures competent advice.

FOUNDATIONS FOR

INDUSTRIAL PLANTS, POWER PLANTS, STEEL PLANTS, PIERS AND DOCKS, BRIDGES, WAREHOUSES, AIRPORTS, HOUSING PROJECTS, SCHOOLS, COMMERCIAL BUILDINGS, ETC.

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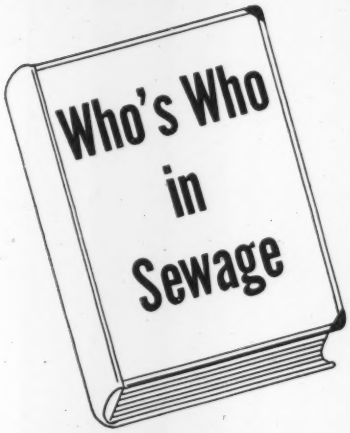
CORROSION PROTECTION FOR H-BEAM PILES

WESTERN FOUNDATION CORPORATION

308 W. Washington St., Chicago 6, Ill. • 2 Park Avenue, New York 16, N. Y.



puts Worthington FIRST for Engines

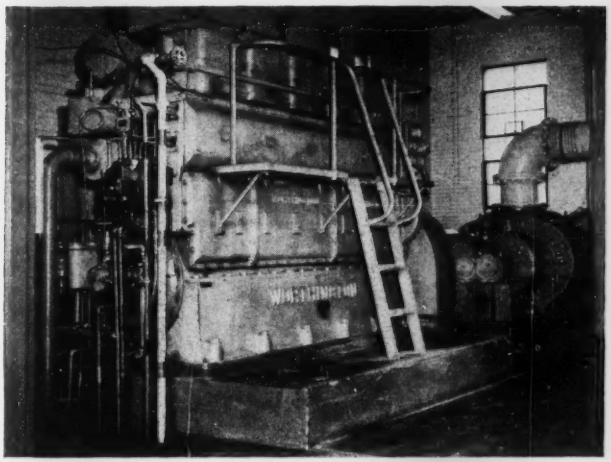
If there were such a book as "WHO'S WHO IN SEWAGE", we're sure Worthington would lead the list in engines sold and total hp in the larger size units.

Over its 17 years of experience in the field, sewage plants have purchased 106 Worthington units, with a total installed hp of 46,000.

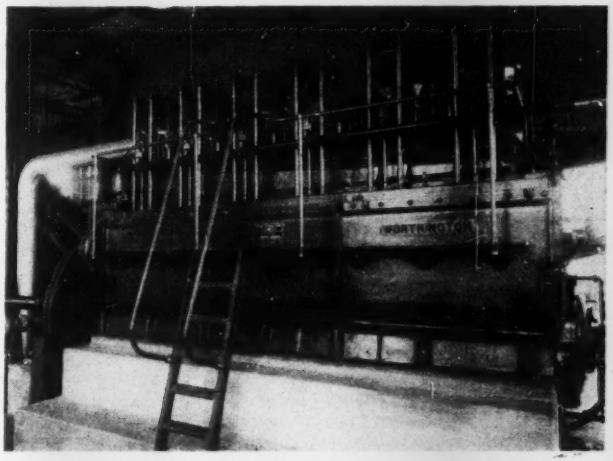
Worthington offers dual fuel or spark-ignition engines, atmospheric or supercharged, for blower, pump, generator or combination drive. All engines give you the economy and trouble-free performance that result from such Worthington features as:

- **governor-controlled, balanced-plug type metering valves on each cylinder**
- **mechanically-timed gas injection valve on each cylinder**
- **automatic thermal air throttling control**
- **dual-plunger fuel pumps**

For further information on engineering and application of engines in sewage plants, remember *there's more worth in Worthington* and consult with our nearest office. Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.



Phoenix, Arizona Sewage Department installed Worthington Dual Fuel Engines in 1949 to drive blowers.



Peoria, Illinois Sanitary District installed this Worthington Gas Engine in 1935 to drive blowers.

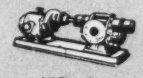
WORTHINGTON

E.17

ECONOMICAL CONTINUOUS POWER
Diesel Engines, 150 to 2640 hp
Gas Engines, 190 to 2880 hp
Dual Fuel Engines, 345 to 2640 hp

WORTHINGTON-BUILT AUXILIARIES

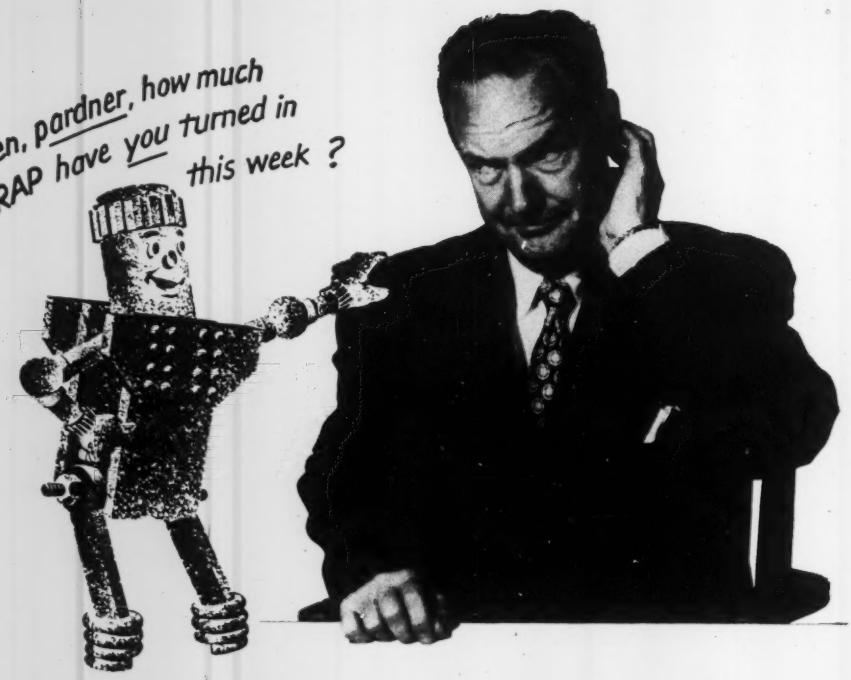
Balanced Angle Compressors



Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Coolers



Today, the steel business is your business

—*it needs all your SCRAP, Now!*

SUPPOSE that every steel user were suddenly told that he had to turn in a half-ton of scrap before he could get a ton of steel. It would start the most gosh-almighty treasure hunt for scrap that ever happened.

In effect, this "no-scrap, no-steel" situation virtually exists. For without *all* the scrap that industry can search out and start on its way to the mills, steel production will surely drop. It's as serious as that.

More scrap is urgently needed. Today the mills are turning out more steel than ever before. But they're scraping the bottom of the barrel as far as scrap is concerned. Defense and domestic demands for steel simply cannot be met unless at least 100,000 tons of "purchased" scrap roll into the furnaces—*every day.*

The bulk of this scrap must come from industry. That's why we're asking for your all-out help. That's why it's so important that you make the drive for scrap part of your daily operations. Make it your business to encourage every employee to report any obsolete, broken or worn-out machinery, tool or equipment that has seen its day. From this dormant "junk" must come the heavy melting scrap that the mills need most. Don't let your scrap lie idle; send it on its way. How about it, pardner?

You'll find your local scrap dealers listed in the yellow pages of the phone directory.

This page would ordinarily be used to tell you about

U·S·S STEEL SHEET PILING

but, because without SCRAP we cannot produce steel, we are asking instead for your all-out help in getting more SCRAP to the mills.

UNITED STATES STEEL COMPANY, PITTSBURGH · COLUMBIA STEEL COMPANY, SAN FRANCISCO
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Like the Hunter and His Dog . . .

they Go Together

ALL-WHEEL DRIVE

and ALL-WHEEL STEER

What makes it easy for the front truck to ride the bank? . . . ALL-WHEEL DRIVE!

What keeps the rear truck running smoothly down on the road? . . . ALL-WHEEL STEER!

On jobs like this, and hundreds of others, this pair of exclusive Austin-Western features works as a team to do better work, and more of it. A profusely illustrated catalog which tells the whole story is yours for the asking.

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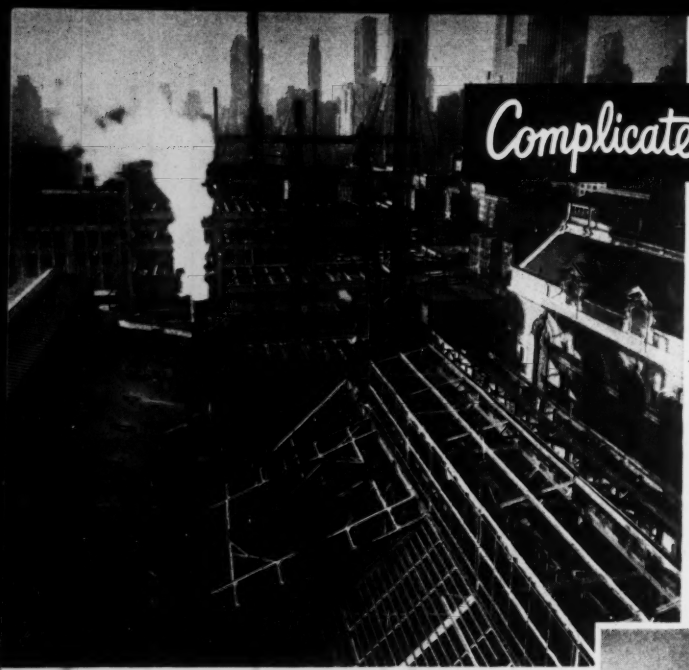
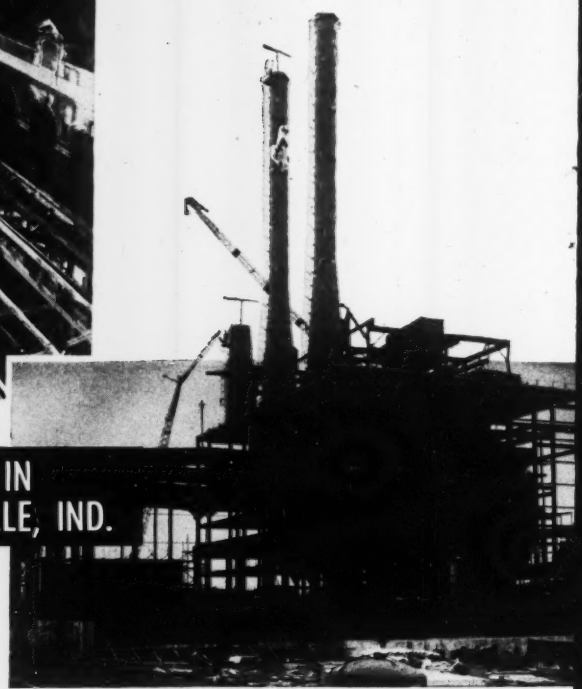


Complicated DEEP IN THE HEART OF NEW YORK CITY

Waterside No. 1 Generating Station, for Consolidated Edison Company of New York, Inc., designed by Consolidated Edison Company.



Straight-forward OUT IN NOBLESVILLE, IND.

Noblesville Power Station, Noblesville, Indiana, Public Service Company of Indiana, Inc. Designed by Sargent & Lundy.

You can depend on American Bridge to build it right!

THE pictures above give you a pretty good idea of American Bridge Company's versatility. We fabricated and erected all steelwork for both power plants.

The reconstruction of Consolidated Edison's Waterside No. 1 Generating Station in a congested area of New York City involved a number of out-of-the-ordinary working problems. It called for complete new steelwork for the boilerhouse and west electrical gallery buildings, new turbine foundations, and new bus tie between the east and west galleries. These necessitated complicated shoring and alterations, and the skillful maneuvering of heavy girders and construction equipment.

American Bridge Company has the know-how and experience, plus the men and equipment to handle either type of job speedily and economically. Just call our nearest Contracting Office.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

Contracting Offices in: AMBRIDGE · BALTIMORE · BOSTON · CHICAGO · CINCINNATI
CLEVELAND · DENVER · DETROIT · DULUTH · ELMIRA · GARY · MINNEAPOLIS · NEW YORK · PHILADELPHIA · PITTSBURGH
PORTLAND, ORE. · ST. LOUIS · SAN FRANCISCO · TRENTON · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS TRADE MARK

AMERICAN BRIDGE

UNITED STATES STEEL

Check these DORRCO DISTRIBUTOR features

against high-rate trickling filter requirements

Distributors for high-rate trickling filters have to be *mechanically* right to handle heavy loadings. Check these mechanical features of the Dorrco Distributor against those of other units...

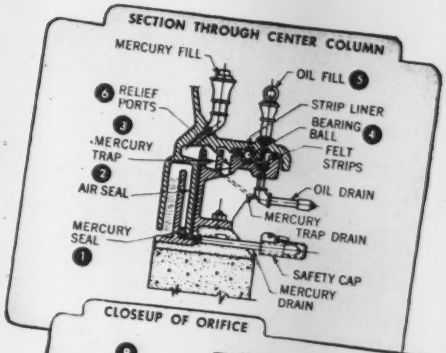
MERCURY SEAL... between rotating and fixed element (1) . . . is protected from contact with sewage by a positive air seal (2). In case of excess surge of pressure sufficient to blow the seal, the mercury is caught in an annular drain trap (3).

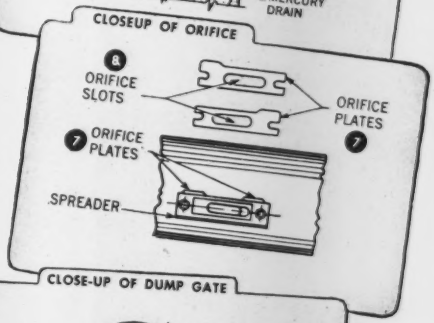
BEARINGS... Large diameter ball bearing race (4) running in oil at *base* of turntable for stability . . . is easily lubricated (5). Relief ports (6), provided for emergency overflow, prevent flooding of bearings under any circumstances.

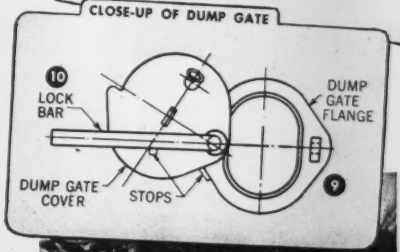
ADJUSTABLE ORIFICE PLATES... Two separate sliding plates (7) are bolted one upon the other to permit final flow adjustments. Orifice slots (8) are elongated to minimize clogging.

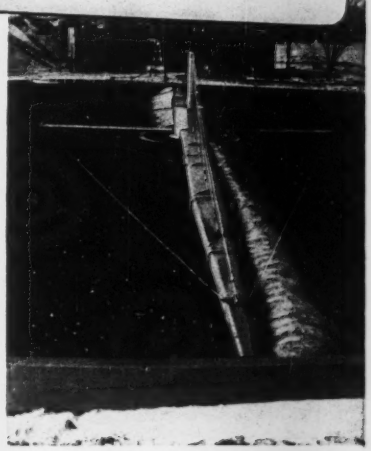
QUICK-OPENING DUMP GATE... provided at the end of each arm (9) is opened and closed easily by means of the lock bar (10).

Dorrco Distributors are available with two or four arms . . . having one or two compartments. On heavy duty units, the arms are of fabricated steel plate . . . tapered for better hydraulic performance and more uniform distribution. *The sum total of all these points is smooth Dorrco Distributor performance under the most severe of operating conditions.*









DORRCO

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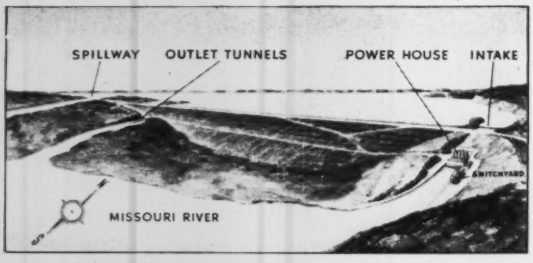
WORLD - WIDE RESEARCH • ENGINEERING • EQUIPMENT

THE DORR COMPANY • ENGINEERS • STAMFORD, CONN.

Offices, Associated Companies or Representatives in the principal cities of the world

Big Red TD 24

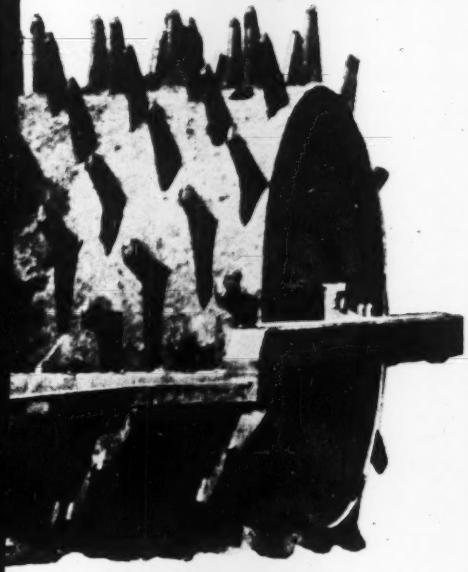
BREAKIN' SHALE ON THE BERM. TD-24 pulls a 60,000-lb. capacity spike-tooth roller, evening surface of uncompacted berms. Five TD-24s are literally "all over the place" on this big project's toughest jobs.



ARTIST'S CONCEPTION OF OAHE DAM at completion in 1959. Power works above will provide 420,000 kw with 6 generators, twice as much power as South Dakota produces at present. 78 million cubic yards of earth are involved.

BIG RED REALLY KEEPS THE LOADS MOVING—Whether it's pushing or pulling, TD-24's great power and speed enable it to move more pay dirt faster.

Rolls Out the Wrinkles on Oahe Dam



Five International TD-24s star on dam project, harnessing the "Big Muddy," creating a 250-mile lake and irrigating two million South Dakota acres.

Contractor's superintendents, dirt boss and skinners at the big Oahe Dam project on the Missouri River near Pierre, South Dakota—all will bend your ear about "Big Red."

Operator Troy Hood goes on record: "Cutting on a curve, TD-24's Planet Power steering keeps both tracks pulling so you keep all power working to do a faster job."

Here's another TD-24 skinner, Jack Rank: "Son-of-a-gun really has got the power. Much easier to handle than other tractors, easier to work, easier on me. I'm on it 10 hours a day, so I know."

Dirt Foreman Sam Crawford backs them up: "TD-24 can't be beat. We haven't found anyplace it won't go."

John P. Beck, general superintendent for subcontractor Campbell-Collins, has high praise for "Big Red": "We're well satisfied with our TD-24s. Their speed in reverse certainly is an advantage as no time is lost between pushing runs behind our ten scrapers."

There they are—solid reasons for TD-24 preference by the men who move the dirt.

Take their word for it. See your nearest International Industrial Distributor for the facts behind enthusiastic TD-24 performance reports making the rounds. Find out how he backs up the power he sells with full stock of parts, factory-trained mechanics, and the latest service equipment, to keep your equipment in the high output bracket.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

"WE LIKE TD-24 POWER," says John P. Beck of Campbell-Collins (left). Looking on are F. A. Bleecker of Guy H. James Co., prime contractor; L. G. Leavitt, area engineer; and F. P. Evans, office engineer.

INTERNATIONAL HARVESTER

INTERNATIONAL

POWER THAT PAYS

Do your highways have that "GAY NINETIES" look?

That pinched waist look may have been alright on a "gay nineties" girl. But when caused by narrow bridges on your highways it is a definite hazard to safety and smooth flowing traffic.

Engineers have found that Armco Drainage Structures provide a simple low-cost answer. When the original structure is sound, the desired extra width can frequently be provided by extending with Armco MULTI-PLATE or Corrugated Metal Pipe. Failing structures can be economically relined and extended, or completely replaced if necessary.

But this is just one example of the way Armco Drainage Structures are helping engineers make needed improvements at low cost.

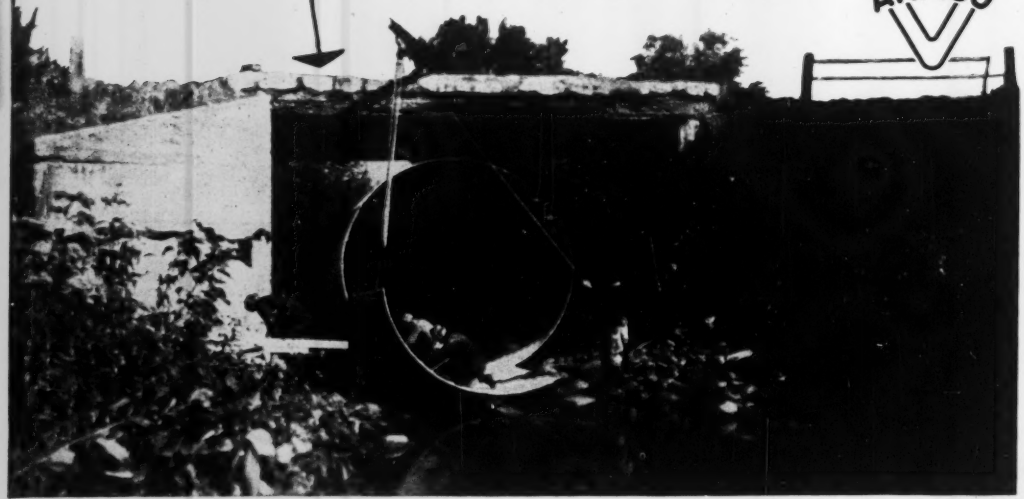
You'll also be interested in Armco PIPE-ARCH, as an answer to limited headroom; Armco PAVED-INVERT Pipe to guard against erosion; and Armco ASBESTOS-BONDED Pipe (a completely new idea in metal protection) to meet severe corrosion.

Ask us for complete data. Armco Drainage & Metal Products, Inc., 1871 Curtis St., Middletown, Ohio. Subsidiary of Armco Steel Corporation.

Export: The Armco International Corporation

Armco Drainage Structures

ARMCO



How to get

MORE WORK

from your "Cat" Motor Grader!

HERE'S the situation in a nutshell. The speed, versatility and big work capacity that have made "Caterpillar" Motor Graders an essential construction tool have also made them necessary to the defense effort. As military orders must be filled first, you may not be able to obtain prompt delivery of new machines. So it will pay you to plan *now* to get greater production and longer wear from your present equipment.

"Cat" Motor Graders are ruggedly built for long life. But good care on your part can lengthen that life span by thousands of extra service hours. Here's how:

1 Follow the recommended *operating* care in your Operator's Instruction Book. Read and reread it.

2 Observe the *maintenance* suggestions in the Operator's Instruction Book. They're down-to-earth — experience has proved them practical and effective.

3 Anticipate your future replacement parts needs by seeing your "Caterpillar" dealer about them *now*. Don't wait until wear gets beyond repair — many a part can be rebuilt *if* serviced in time.

You're in good hands when you work closely with your "Caterpillar" dealer. He is anxious to help you solve your problems. He has the skilled mechanics and service facilities to help you lick them and keep your equipment in shape.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

You're the Doctor Preventive maintenance is good medicine for long life. Your Operator's Instruction Book is invaluable in the fight to conserve machine life. Follow the operation, lubrication and maintenance recommendations. When wear is evidenced in cutting edges, gears, tires or engine, see your "Caterpillar" dealer. He can help you prolong the life of your motor grader. Your motor grader is essential—don't abuse it!

Fast worker—reliable, too! This "Caterpillar" Diesel No. 12 Motor Grader is one of thousands that help construction men meet their contracts on schedule. An essential earthmoving tool, it stands up under tough going — handles easily. As a military tool, it's essential for airport construction and maintenance, road construction, the establishment of bases and scores of other jobs.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS

EARTHMOVING EQUIPMENT

A Marathon Runner...like Cast Iron Pipe...has

To run 26 miles over hill and dale in 2½ hours requires strength and endurance,—in a word, *stamina!* To carry on for 100 years or more, as cast iron water and gas mains are still doing in 38 American cities, also requires stamina. These rugged mains, installed in the days of horse-drawn vehicles, are now withstanding the traffic-shock of multi-ton trucks and buses and the soil disturbances caused over the years by underground construction of sewers, power lines, telephone conduits and subways. Yet cast iron pipe has survived these changes because of its crushing-strength, shock-strength and beam-strength.

No pipe deficient in these strength-factors of long life should ever be laid in paved streets of cities, towns and villages.

CAST IRON PIPE

STAMINA!*

*The Marathon race, blue-ribbon event of the modern Olympic Games (first held in Athens, Greece in 1896) was won in the record time of 2 hours 29 minutes 19.2 seconds in 1936.

CAST IRON

CAST IRON PIPE RESEARCH ASSOCIATION; THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

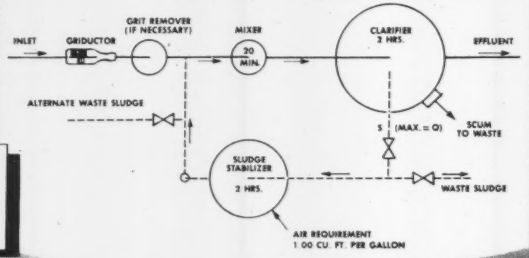
SERVES FOR CENTURIES

It's NEW!

Infilco's Biosorption Process

Write for data on Infilco's new activated sludge treatment method. Ask for Bulletin No. 6550.

Suggested flow diagram with retention based on average flow of normal strength domestic sewage



RESULTS FROM ACTUAL INSTALLATION

Sewage Treatment Plant, Austin, Texas

THREE MONTHS TEST PERIOD April May June	① B.O.D. % Reduction	② SUSPENDED SOLIDS % Reduction
Avg.	93.6	93.7
Max.	98.7	97.7
Min.	89.6	90.6
Avg.	93.6	94.0
Max.	97.7	97.5
Min.	88.0	88.9
Avg.	95.6	96.0
Max.	98.8	99.1
Min.	93.6	92.4

1 B.O.D. % Reduction

2 SUSPENDED SOLIDS % Reduction

RETENTION BASED ON AVERAGE FLOW

Mixer	31 minutes
Stabilizer	2.7 hours
Clarifier	2.4 hours

3 RETENTION

AFTER 12-MONTHS TESTING
in pilot plant studies . . . and now proved by actual installation . . . the Biosorption Process is showing phenomenal results in high-rate biological oxidation sewage treatment

IMPORTANT SAVINGS
in space requirements and initial investment are brought about with total retention time of only about four hours. B.O.D. and suspended solids reductions compare with the optimum obtained by conventional activated sludge treatment methods. Write today for this important test data on the BIOSORPTION PROCESS . . . ask for Bulletin No. 6550.

INFILCO
• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

INFILCO, INC., *Tucson, Arizona*

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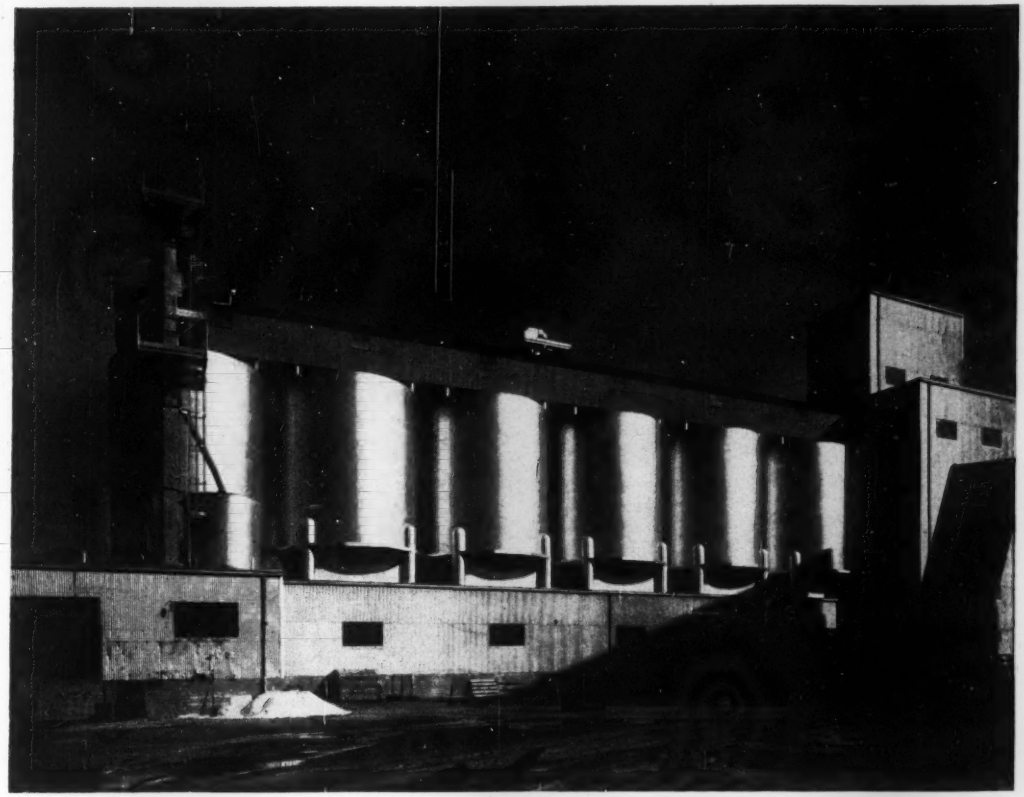

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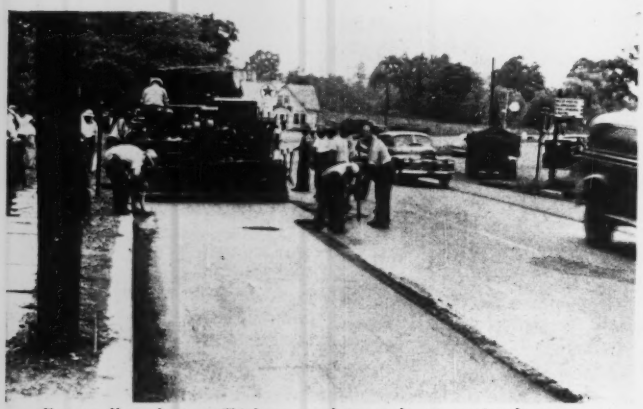

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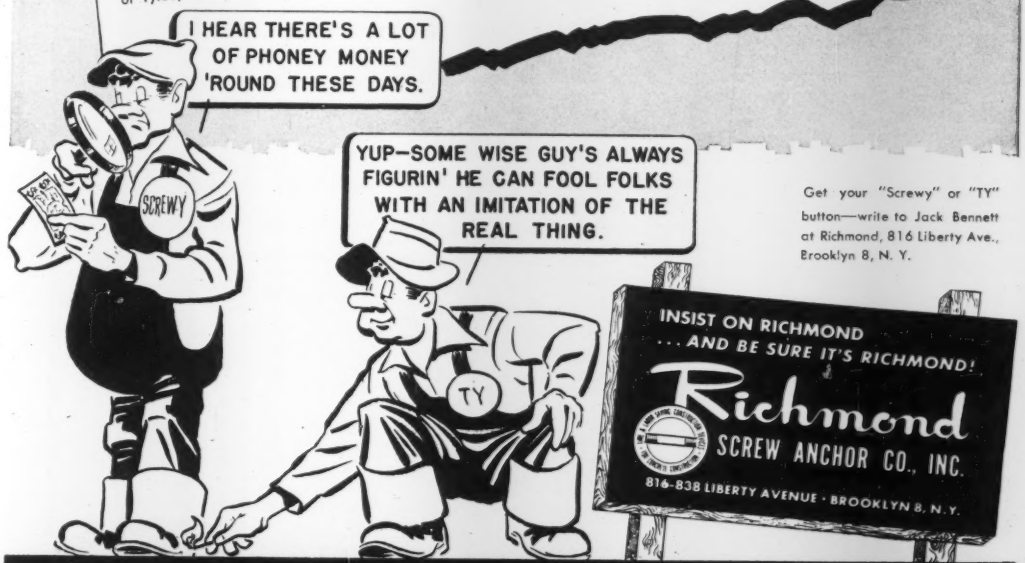
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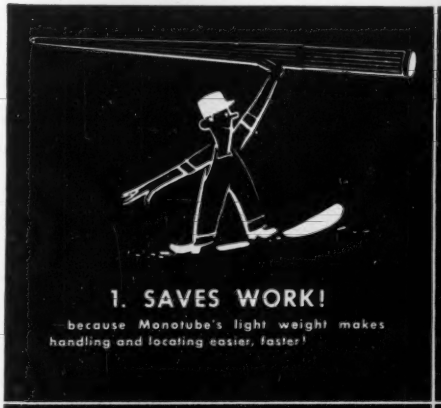

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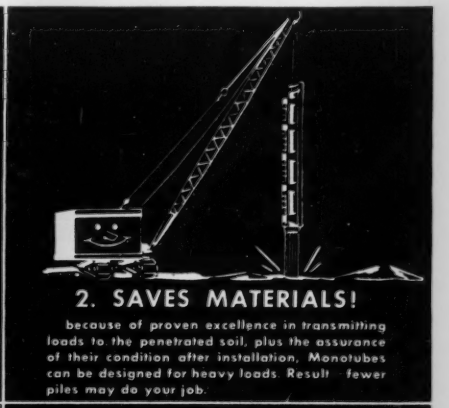

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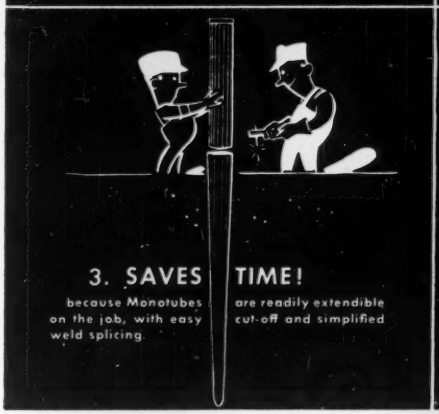
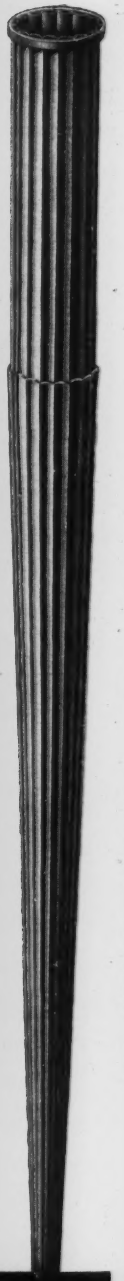


3. SAVES TIME!

because Monotubes are readily extendible on the job, with easy cut-off and simplified weld splicing.

4. SAVES WORRIES!

because tubular design permits rapid, sure inspection before concreting.



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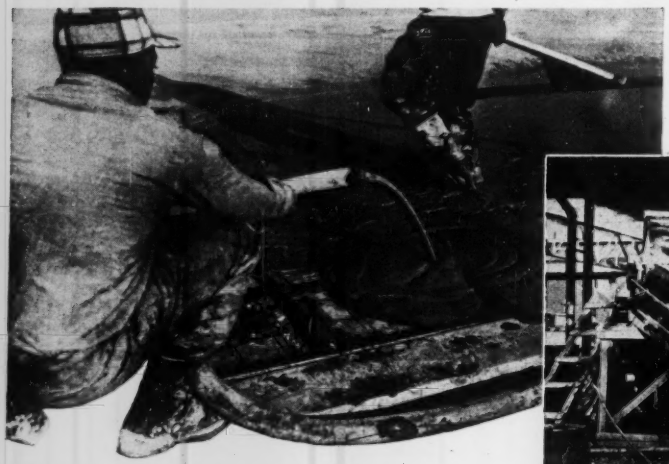

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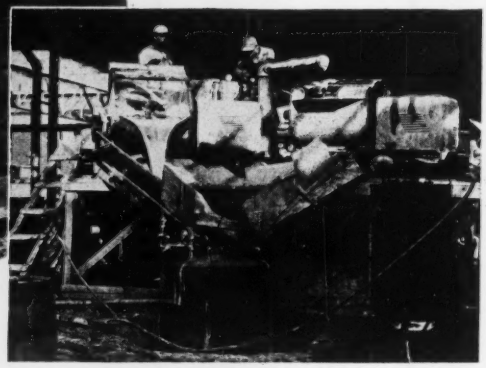

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Annual Convention, New York, N.Y. . . . . October 22–26

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

...A Tall Order

"Two years ago I was called in by a large company which had purchased 40 acres of farm land as a site for buildings worth $5,000,000," recalls Stanley M. Shartle, Registered Land Surveyor of Danville, Indiana. "Besides a certified land boundary, they required a topographic map showing elevations to the nearest 0.1 ft. at the approximate corners of 50-ft. grid squares covering the entire area.—*And they wanted it done yesterday.*"

"The terrain was flat and timberless. It looked easy. But, at the site, I found corn standing more than 8 ft. tall everywhere and visibility nil. My orders were to 'cut not one stalk'; so I searched for a vantage point. All I found was more corn.

"Surprisingly, the north and south rows of corn proved to be almost in true meridian; and east and west rows were practically perpendicular. This made the location of the grid corners easy to establish without a transit.

"But for leveling I was desperate, 'til an idea hit me: remove the sliding legs from the extension tripod and replace them with 10-ft. lengths of 1-inch thinwall conduit which fit snugly into position. This giant tripod put the level's telescope 12 feet above the ground. On a 12-ft. ladder, I was able to see over the corn easily. It wasn't yesterday when I finished, but pretty darn close."

Corn "high as an elephant's eye" *created leveling problem for Stan Shartle. Solution: extend tripod legs with conduit.*

Remedy for "Frozen" Tripods

Did you ever have an instrument "freeze" to the tripod out in the field? Chances are that nothing you tried would budge it.

The next time it happens, take a tip from a cadastral engineer: spread the tripod legs apart until the instrument is a foot above the ground. The instrument will then come off easily. This engineer first tried the trick 40 years ago; says it's never failed since in any temperature or climate.

Gurley Transit on border survey: *This prominent cadastral engineer—who suggests the above method for "unfreezing" a tripod—used his Gurley Solar Transit in resurveying the Colorado-New Mexico boundary.*

Write for Bulletin 50 giving complete details on Gurley transits, levels and other engineering instruments. And enclose a surveying tip for this page.

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SANTA CECILIA DAM, shown during second-stage construction, provides regulated pool at intake to Santa Cecilia pump station. Spillway capacity exceeds record flood flow. Small Tainter gate at right passes small discharges for benefit of downstream riparian owners.

Paraiba-Pirai Diversion Project to fill Rio de Janeiro's power needs up to 1960

ADOLPH J. ACKERMAN, M. ASCE, and FRANKLIN T. MATTHIAS, M. ASCE

Respectively Vice-President and Construction Manager, Hydroelectric Construction Dept. of COBAST, Rio de Janeiro, Brazil

and GEORGE O. VOGAN, Manager, Engineering Projects Division, Canadian Brazilian Services, Ltd., Toronto, Canada

AMONG BRAZIL'S great natural resources is an abundance of potential hydroelectric power, a generous amount of which is well located in relation to the great market of Rio de Janeiro (Fig. 1). This city, with a population of $2^1/_2$ million, is the fourth largest city in the Western Hemisphere. The principal supplier of electricity in the city and state of Rio de Janeiro, is the Rio de Janeiro Tramway, Light and Power Co., Ltd. (known in Rio as "the Light"), a subsidiary of the Canadian corporation, Brazilian Traction, Light and Power Co., Ltd., of Toronto.

At present the "Light" system consists principally of two interconnected developments operating at 50 cycles—the Lages development (Fig. 1) with its power plant at Fontes, a high-head storage plant of 149,000 kw, and the Ilha dos Pombos development, a run-of-river plant of 162,000 kw on the lower Paraiba River. During the wet season Ilha dos Pombos carries the base load while Fontes carries the peaks, and during the dry season Fontes carries the base load with water drawn from storage, while Ilha dos Pombos carries the peaks by utilizing its daily pondage. Since the energy available during the wet season from Ilha dos Pombos exceeds the night demands, excess power is sent to São Paulo over a 206-mile transmission line recently constructed. During the dry season the São Paulo system feeds back energy from its greater storage resources to help in meeting the demand in Rio de Janeiro.

Topography Favors Major Developments

The opportunity for major hydroelectric developments is provided by the unusual topography of southeastern Brazil. A plateau, the Serra do Mar, rises a few miles inland from the Atlantic ocean and parallels the coast for nearly 1,300 miles. This plateau varies in height from 1,000 to 2,500 ft. Since it tilts slightly away from the coast, nearly all the streams flow inland, where the rainfall is heaviest, and form large rivers such as the Paraiba, Tietê, and Paraná, which empty into the ocean to the north or to the south, hundreds or even thousands of miles away.

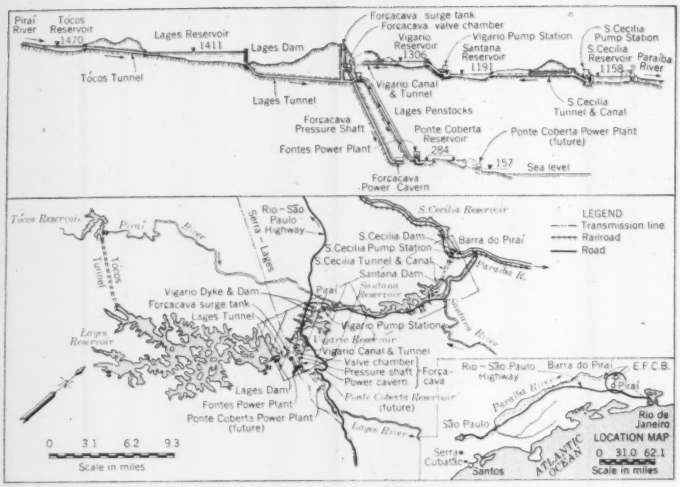
When the Rio "Light" built its first plant at Fontes in 1908 under the general direction of F. S. Pearson, he utilized one of the few over-the-edge streams, or natural waterfalls, known as the Lages River. A 105-ft-high gravity dam was built across this river above the falls. From the reservoir so formed a series of tunnels and feeder pipes extend to the escarpment, where a head of 1,030 ft is developed through six penstocks (in the first stage) connected to six 4,000-kw vertical-shaft generating units of the Pelton type (see Fig. 1, at right, for map and elevation).

In 1913 the Lages project was enlarged by building a dam at Tocos on the Pirai River. The water was then diverted by gravity flow through a 5-mile tunnel extending through the divide to the Lages Reservoir. This diversion of part of the Pirai River permitted the installation of two new 10,000-kw units also of the Pelton type, in the Fontes power plant, thereby increasing its capacity to 44,000 kw.

Although this addition represented a relatively modest increase in power, it was an important basic step because it was the first demonstration of the power possibilities to be realized from the diversion of inland-flowing streams, with their large flows, to the escarpment to utilize its great drop for a high head. The most notable applications of this principle were subsequently made in 1927 to 1939 by the late A. W. K. Billings, Hon. M. ASCE, in the construction of the Serra do Cubatão development near São Paulo (see his article in CIVIL ENGINEERING for August 1938, p. 520, for a description of the first stage of this development) and in his projected plans for the large diversion project near Rio de Janeiro.

After the first World War, the increased demand for power justified the construction of a hydroelectric plant at Ilha dos Pombos on the lower Paraiba River with a head of 102 ft, built from 1922 to 1926 under the direction of A. W. K. Billings. Two units of 22,000 kw were initially installed; three additional units totaling another 118,000 kw were installed in 1930, 1937, and 1949.

Operation of the plant at Ilha dos Pombos relieved the Fontes plant from the need of generating power continuously throughout the year. This permitted a greater storage accumulation in the Lages Reservoir from the Lages River and the diverted Pirai River. To utilize as much as possible of this flow during the dry season, the old Lages Dam was raised 92 ft in stages, or to nearly double its original height, from 1941 to 1948.



Raising of Lages Dam, begun in 1941, was an achievement for which there was little precedent. Plans had been made to raise the crest by placing a concrete gravity dam over the old structure, but to limit stresses on the foundation as well as to save hard-to-obtain cement, it was finally decided to construct buttresses up to 202 ft high against the old dam to support the new crest. This procedure resulted in a saving of 35 percent of concrete over that required for an equivalent gravity dam.

The increased storage provided enough water to justify the installation of three additional 35,000-kw generating units in a new extension of the Fontes power station in 1938, 1942 and 1947 respectively. These new units have Francis-type turbines, which when first installed were the highest-head turbines of this type in the world—1,130 ft.

Paraiba-Pirai Diversion Project

The rapid growth of power demand in Rio de Janeiro, which is compounding at the rate of 9 per cent per year, has necessitated a major expansion program. Construction of the Paraiba-Pirai Diversion Project (Fig. 2) near Rio de Janeiro is now in the initial stage. This is the first step in a progressive program of hydroelectric development for increasing the installed capacity of the Rio system to meet the present rate of load growth at least until 1960. The present system has available energy amounting to 1,570,000,000, kwhr per year. Based on average flow conditions, the Paraiba-Pirai Diversion Project should eventually raise the system production to over 4,000,000,000 kwhr per year. Excess energy during the first years will be transmitted to the São Paulo system to meet the rapidly growing demand of that city.

The Paraiba-Pirai project consists essentially of diverting up to 5,650 cfs of water from the Paraiba River at Barra do Pirai, 89 miles above Ilha dos Pombos, and bringing it to the present Fontes power station and to two new underground power stations, Forçacava No. 1 and the proposed Forçacava No. 2, immediately adjacent to Fontes. This diversion from the Paraiba River has been authorized by special government concession. It will somewhat reduce the available energy produced at Ilha dos Pombos, but the diverted water will generate about nine times the energy at Forçacava that it could at Ilha dos Pombos.

Diversion of Paraiba River water begins at Santa Cecilia Dam and pump station (Fig. 3) near Barra do Pirai, and ends at the underground Forçacava valve chamber at Lages, where the flow may be directed either to the Fontes or to the Forçacava power stations. The distance of diversion from Santa Cecilia to Forçacava is 18.5 miles. The flow is not by gravity, two pumping lifts being required, one at Santa

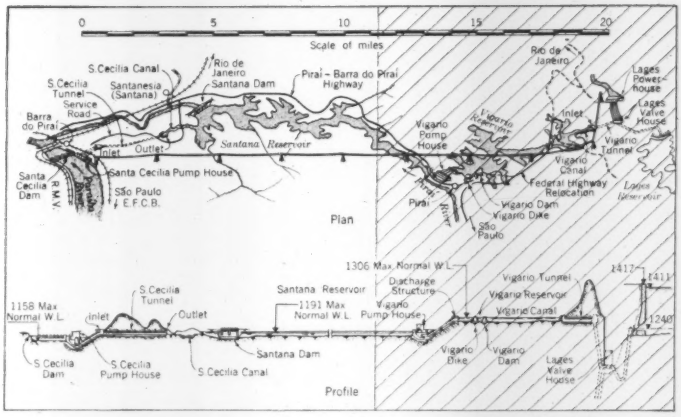


FIG. 1. (Facing page) Construction of Paraiba-Pirai diversion project will increase power available to Rio de Janeiro to over 4,000,000,000 kwhr per year under average flow conditions. Power demand in that city has been compounding at rate of 9 percent per year. Box shows area of Fig. 2.

FIG. 2. PARAIBA-PIRAI diversion project will divert up to 5,650 cfs from Paraiba River to existing Fontes power station, and two new power stations at Forcacava. Flow is pumped up a total of 145 ft with off-peak power. Hatched part of project will be covered in second article, to appear in November issue.

Fig. 2

← Fig. 1

Cecilia and one at Vigario, for a total lift of 145 ft. Most of the pumping will be done with off-peak power. At Fontes, the head at which the pumped water is utilized is 1,003 ft.

Santa Cecilia Pump Station has a maximum pumping capacity of 5,650 cfs and will lift the Paraiba River water 33 ft to a free-flowing tunnel 10,900 ft long. At the tunnel outlet the water enters a canal 4,770 ft long from which it flows into the Santana Reservoir on the Pirai River, formed by damming the river at the village of Santanesia.

At the upper end of the 9.3-mile-long Santana Reservoir, the Vigario pumping plant will lift the water from the Santana Reservoir into the Vigario Reservoir through a height of 111 ft. From Vigario Reservoir, the water will flow by gravity through a short canal and tunnel to the Forçacava valve chamber. Santana and Vigario Reservoirs have relatively little storage capacity, and will be used only for daily and weekly pondage.

Diversion Route Selected

The route selected to bring 5,650 cfs of Paraiba water to Santana Reservoir was chosen after considering several alternatives. From studies made before construction was started, it was found most economical to adopt a site for the diversion dam upstream from the town of Barra do Pirai near Fazenda Santa Cecilia, and to pump the water at this point into a tunnel originally planned to be 3.2 miles long, extending to the Santana Reservoir. The elevation of the inlet end of the tunnel was set sufficiently high to permit the water to flow by gravity into Santana Reservoir. From this point the original diversion route was retained except that the Vigario Reservoir was raised about 23 ft to save the cost of excessive canalization near the Vigario tunnel.

Santa Cecilia Dam on Paraiba River

To provide a regulated pool on the intake side of the Santa Cecilia pump station, a dam 853 ft long is being built across the Paraiba River (Fig. 3). The dam consists partly of an earth embankment and partly of a spillway section formed by a base slab and heavy piers for eight Tainter gates, each 20 ft high and 60 ft long. The normal spillway capacity of these gates is 130,000 cfs, substantially above the maximum flood on record at this point. The open gate area is larger than the channel cross section which originally existed at this site, so that no backwater effect will be introduced by the dam during high flood stages. A small Tainter gate has also been provided next to the pump station for passing the smaller discharges which must be released for the benefit of downstream riparian owners.

Each Tainter gate is operated by an individual motor installed on top of one of the piers. Each motor is coupled through a clutch and long shaft to the adjacent gate motor so that it can raise the adjacent gate in case of failure of its motor. The gates can be held in any intermediate position between closed and open, and are lifted by means of a braided flat cable 9.4 in. wide and $^3/_4$ in. thick, which rolls on a spool like a ribbon.

In periods of low water, the gates in closed position will maintain a pool about 20 ft deep, and in flood seasons the gates can be opened above high-water level.

As the Paraiba River drains a watershed characterized geologically by deep weathering and disintegration of the original rock formation, it carries a very high sand and silt load. Consequently one of the main design problems was to devise some method for preventing the entrance of coarse and abrasive bed sediments into the pumps. The main dam was designed with its sill below the normal river bed, so that the bed load of sand would readily pass on downstream. Furthermore, silt deflecting walls were designed on the basis of model studies (See CIVIL ENGINEERING, January 1951, p. 44) to divert the bed load through the spillway gates and away from the pump station.

During flood periods, when most or all of the Tainter gates are open, the outer sill will deflect the greater part of the silt load. Any bed material which finds its way over this sill will be sluiced out through the end gates by the spiral eddies formed between the outer and the intermediate sills. During dry periods, the space between the sills will act as a settling basin, and a slight opening of the

Tainter gates adjacent to the pumphouse will sluice out the settled material.

Four Pumps of Vertical-Shaft Type

Santa Cecilia pump station (Fig. 3, below) will have four pumps, each of 1,410-cfs capacity, and will be operated continuously even during peak-load hours to divert all the available water as authorized under the concession.

Each Santa Cecilia pump is of the vertical-shaft type with a single Francis-type impeller, and is capable of pumping against a dynamic head of 48.2 ft. Each pump is rated at 9,500 hp and is driven by a 50-cycle synchronous motor running at 166⅔ rpm. The first pumping unit is scheduled to go into operation in December 1951, and the second and third units during the second half of 1952.

The pump scroll-case is of welded construction and has a discharge diameter of 13.1 ft. Water from the scroll case passes through a 13.1-ft-dia butterfly valve to an underground concrete-lined penstock 279 ft long and 13.1 ft in diameter, extending under the tracks of the Central do Brasil Railroad to the Santa Cecilia tunnel intake.

When starting the unit as a pump, or operating it as a synchronous condenser, the butterfly valve is closed and the water level is depressed below the impeller by means of compressed air injected into the scroll case. The butterfly valve remains closed until and after the unit has been brought up to synchronous speed. For pumping service, the air pressure is released gradually, and after the full discharge water pressure had been built up in the scroll case, the valve is opened gradually to establish full flow into the tunnel.

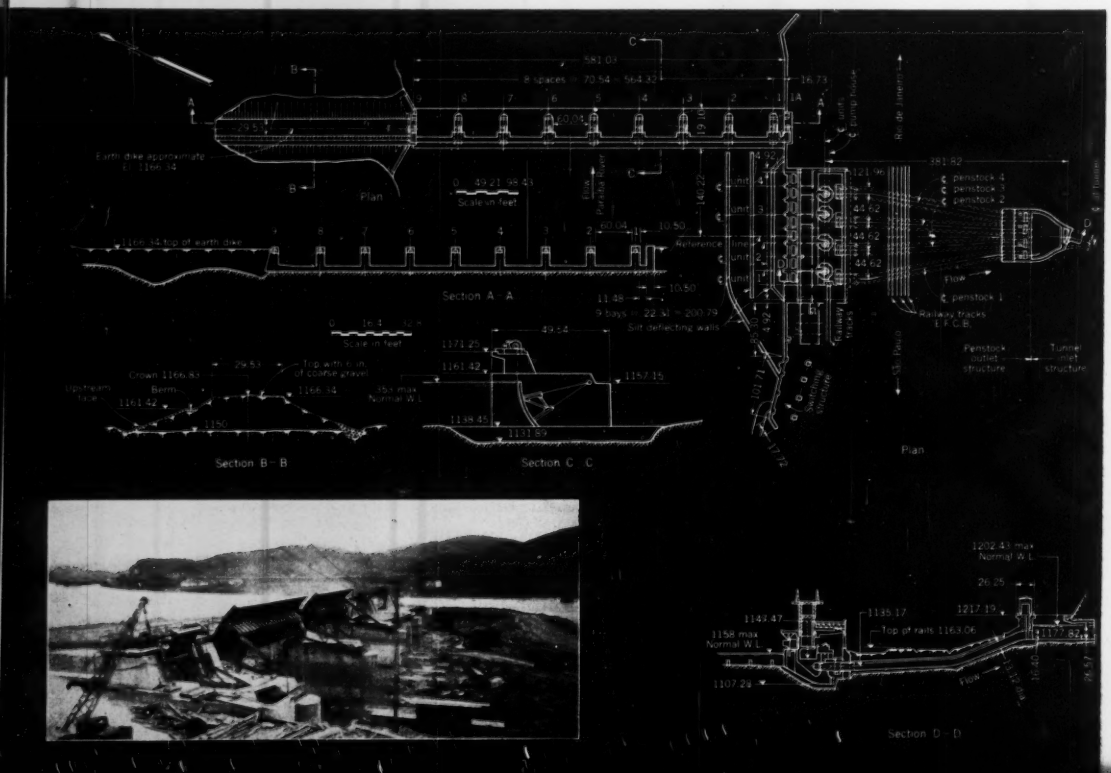
The main diversion tunnel was initially planned to have a length of 3.2 miles. However, after tunnel driving had started, further surveys and studies disclosed that a change in the direction of the tunnel would permit it to be connected to the reservoir by an open canal thereby reducing its length to 2.1 miles. The result of this change was a reduction in the construction time of the over-all project as well as a more economical combination of water passageways. Shortening of the tunnel permitted a reduction in cross section in the remaining length from 513 to 436 sq ft. The tunnel is of horseshoe section with a height varying from 26.57 to 22.64 ft and a radius of 11.2 ft.

Driving of the tunnel was performed by modern North American methods. A drill jumbo traveling on rails was used. Excavation was done by Conway muckers loading into 5 cu yd muck cars, which were shifted by an electric hoist "cherry picker" and diesel locomotives. The concrete lining was placed by a pneumatic placer behind standard movable steel forms.

Canal Design Based on Model Studies

Santa Cecilia Canal is 8,200 ft long and consists of three sections—a 3,020-ft earth section, a 2,290-ft section cut through rock and lined with concrete, and a second earth section 2,880-ft long. (See CIVIL ENGINEERING for January 1951, p. 44.) The layout required the use of three large transition structures: (1) an expansion from the tunnel outlet to the first earth section; (2) a contraction from the earth section to the lined rock cut; and (3) an expansion from the rock cut to the second earth section.

The design criterion for the two expansion transitions was to keep the velocity distribution as uniform as possible and to reduce head losses and scouring action to a minimum. Other model studies showed that



the desired uniform distribution of flow could be maintained by placing splitter walls at the expansion transitions to spread and guide the water. These walls are similar to the vanes found in a modern wind tunnel.

Santana Reservoir is formed by Santana Dam (Fig. 4), a small dam with a height of 36 ft and a length of 360 ft, of which 198 ft consists of an earth embankment. The spillway consists of two Tainter gates exactly like those on the Santa Cecilia Dam, plus a small broome gate and sluiceway used initially for river diversion during construction, and designed for releasing small discharges after the project goes into service. The spillway apron contains baffles for energy dissipation during the infrequent flood periods when the Vigario pumps may not be able to divert all the Pirai's flood waters.

The remaining features of the Paraiba-Pirai diversion project, including the Vigario Pump Station, Vigario Dam, Dike, Tunnel and Canal, and Forçacava underground power station, will be described by the same authors in the next issue of CIVIL ENGINEERING. Forçacava No. 1 when completed will be one of the largest underground power plants in the world, with an installed capacity of 330,000 kw. Forçacava No. 2, in design stage, will have a capacity of 390,000 kw.

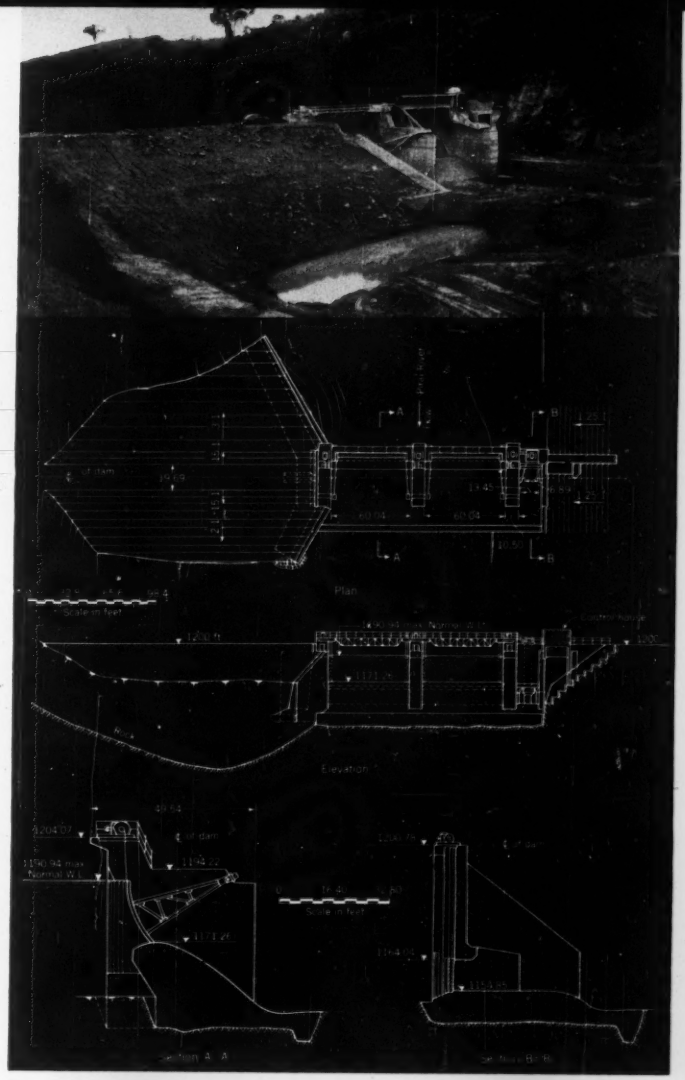


FIG. 3. PLAN AND SECTIONS of Santa Cecilia Dam and pump house (facing page) show sill placed below natural river bed, and deflecting vanes in front of pump house. Both these features were adopted to overcome very high sand and silt load carried by river. Photo at far left shows two of eight 20 x 60-ft Tainter gates in place in spillway section.

AGGREGATE and batching plant (below) is made ready for construction of Santa Cecilia Dam and pump house. In spillway section (below, right) each Tainter gate has its own motor, which can also be used to operate adjacent gate if necessary.

FIG. 4. SANTANA DAM (photo, plan, elevation, and cross sections above) is small structure used to close Santana Reservoir. Gates are exactly like those of Santa Cecilia Dam. Spillway section is designed to handle small discharges when Vigario pumps may not be able to divert all of Pirai flood waters. Photo at top of page shows earth fill and spillway section in place.

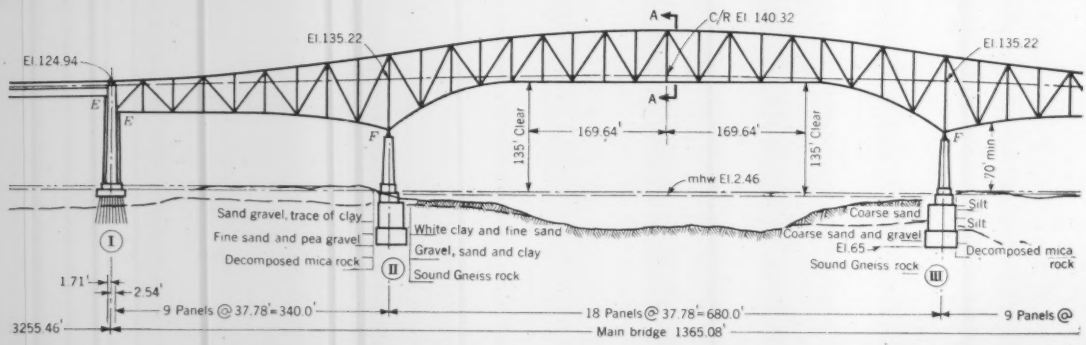
FIG. 1. PENROSE Avenue Bridge replaces 70-year-old, low-level Penrose Ferry Bridge, inadequate two-lane swing span. Ocean-going vessels use Schuylkill River upstream to Passyunk Avenue Bridge.

Philadelphia's

RECENTLY COMPLETED across the lower Schuylkill River in South Philadelphia, the Penrose Avenue Bridge has a number of notable features. First, because it crosses the lower river (Fig. 1), where vital interests are served by ocean-going shipping, it was necessary to design it as a high-level bridge with a vertical clearance of 135 ft, equal to that of the Brooklyn Bridge, yet at the same time it is close to the Philadelphia International Airport, and on that account must be low and specially lighted to avoid danger of airplane collision. Second, its land approaches are built over river fill, which is subject to settlement. Third, early completion was urgently needed to replace the nearby 70-year-old Penrose Ferry Bridge, a swing span which was knocked out of commission by an accident in 1947 and even before that was so inadequate that traffic in rush hours was backed up a mile. And fourth, although the new bridge project has a length of over two miles, its alignment is perfectly straight from end to end, and it is almost perfectly symmetrical about the river (Fig. 2).

Design of the Bridge

Before completion of the foundation borings and determination of the navigation requirements, the five different types of structure shown in Fig. 3 were considered for the river crossing. On account of proximity

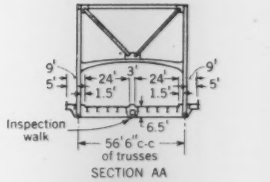


PHILADELPHIA's newest bridge is high-level structure over Schuylkill River, completed this fall at cost of 12 million dollars. It provides badly needed highway facility for both local and through traffic.

Penrose Avenue Bridge opened to traffic

FRANK M. MASTERS, M. ASCE, Modjeski & Masters, Harrisburg, Pa.

to the airport it was, of course, important to keep the structure as low as possible to eliminate aerial hazards. Yet the vertical navigation clearance for shipping was set at 135 ft, so it was necessary to keep the depth above the roadway deck as low as possible. The economic studies of these five types of span, completed when foundation conditions had been determined, promptly eliminated the self-anchored suspension and the tied arch-cantilever on account of their great height and excessive cost. Besides this, foundation settlements, if they occurred, would make the self-anchored suspension bridge unsuitable. The same arguments of economy and height also eliminated the



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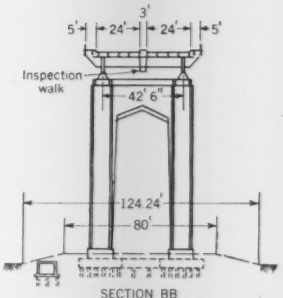

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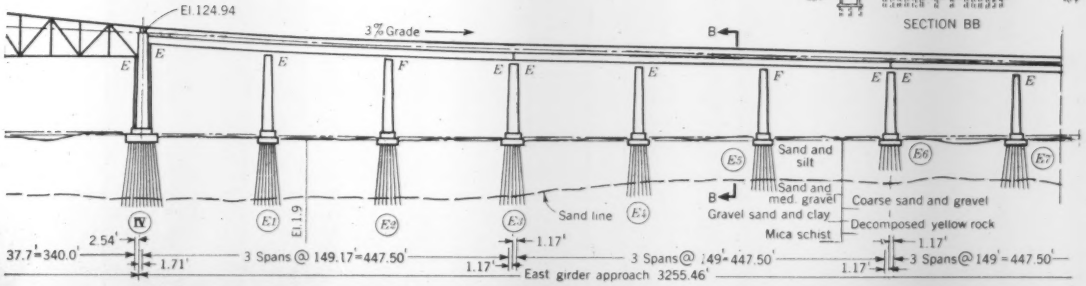
FIG. 2. BRIDGE FOUNDATIONS were carried through river silt, which was 75 ft thick on east end, to compact sand and gravel stratum. Concrete batter piles support approach piers. Caissons for main piers were sunk to El. −65, into sand and gravel which overlies decomposed rock stratum.



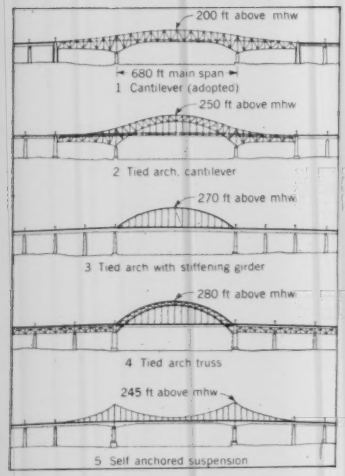

200 ft above mhw
680 ft main span
1 Cantilever (adopted)
250 ft above mhw
2 Tied arch, cantilever
270 ft above mhw
3 Tied arch with stiffening girder
280 ft above mhw
4 Tied arch truss
245 ft above mhw
5 Self anchored suspension

FIG. 3. STUDIES OF FIVE BRIDGE TYPES resulted in adoption of cantilever for economy, appearance, and ease of erection without falsework. Tunnel crossing was found more expensive than bridge crossing.

SUBSTRUCTURE CONSTRUCTION was begun in March 1948 by Foley Bros., Inc Bethlehem Steel Co. started erection of superstructure in 1950. Bridge was opened to traffic on September 12, 1951.

tied arch with stiffening girder and the tied arch–cantilever.

Furthermore, because of the heavy navigation in the river it was desirable to select a type that could be erected without falsework in the navigable area. Such falsework supports would be required for either of the tied arches and possibly for the tied arch–cantilever. Hence, the cantilever type of structure, shown as (1) in Fig. 3, which has the lowest over-all height and requires no falsework for erection, was adopted as the most suitable for this location, especially as minor differential settlements will in no way affect the integrity of the structure. This type is erected by cantilevering from the two sides to junction in the middle.

Detailed economic comparisons were made of designs (1), (2) and (3) in Fig. 3 for the main river span and its two main piers, with the following results, which reflect the economy of the first design both in use of material and in simplicity of erection:

Design	Relative Cost of Main Span and Two Piers
(1) Cantilever	1.00
(2) Tied arch–cantilever	1.11
(3) Tied arch with stiffening girder	1.32

All these various studies in their preliminary stage were submitted to the firm of Paul P. Cret, now Harbeson, Hough, Livingston & Larson, associate architects on this project, who gave it as their opinion that the cantilever is the most suitable type of structure from the standpoint of architectural appearance at this highly industrialized location.

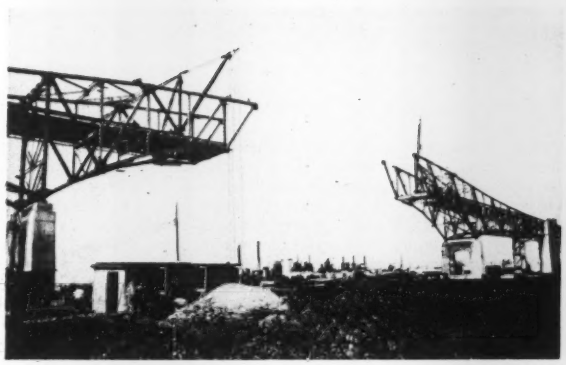
Because of the 135-ft clearance requirement above high water and the necessary height of truss above that elevation, even a bridge of the cantilever type constitutes one of the highest structures in South Philadelphia. Its height of 200 ft is however exceeded by the vertical-lift bridge over the back channel, and the crane at League Island Navy Yard, the U. S. Naval Hospital, and the Girard Point grain elevators.

The main channel span of the cantilever structure is 680 ft and the anchor spans are 340 ft each. The long approaches are of continuous steel girder design in multiples of three spans, supported on high arched reinforced concrete piers founded on concrete bearing piles. These piles have the outer rows battered to increase stability and to spread the loads. The span length in the approaches decreases from 150 ft near the main bridge, to 136 ft, to 108 ft, and finally to 83 ft at the low end of the approaches. As has been mentioned, the east and west approaches are almost exactly the same, which led to some economy in construction.

5-Ft Sidewalks Are Cantilevered Outside Trusses

Outside the bridge roadways there are 5-ft sidewalks, which are cantilevered outside the trusses or girders. Curbs 10 in. high are provided along the roadways. By far the largest part of the bridge is deck construction, which offers practically no interference to the driver's view except in the 1,360 ft of truss spans over the river.

The site of the bridge is a mile and a half above the point where the Schuylkill enters the Delaware. Ocean-going ships use the lower river as far north as the Passyunk Avenue Bridge, and so vital are the industries which they serve that the Department of Wharves, Docks and Ferries and the War Department required a 135-ft vertical navigation clearance above mean high water for any bridge at Penrose Avenue. The channel here is 300 ft wide and has a project depth of 35 ft below low water.



ANCHOR SPANS of main bridge were erected on falsework but channel span was erected by cantilever methods without falsework (above). All steel was furnished and erected by Bethlehem Steel Co. Floor of channel span is steel grid, concrete filled (top right). Finished bridge appears at right.

Like much of this part of South Philadelphia, the ground has been formed by river deposition or man-made fill. A person standing on Penrose Ferry Road, on the east side of the river, can feel the ground quiver as trucks go by. This is a measure of the softness of the river silt, called "mud" in the early borings, which is 75 ft thick at the site. Bridge foundations were carried through this silt, and all approach piers are therefore founded on concrete battered bearing piles which were driven into the underlying compact sand and gravel stratum.

Beneath the sand and gravel, the new borings at the river revealed sound gneiss rock at a depth varying from El. −104 to −117, overlain by 20 ft of decomposed rock. This softer decomposed rock was not distinguished from hard rock by earlier wash borings made in 1929, but in the new borings actual samples were brought up and tested to reveal a material that consolidates like clay. According to the Pennsylvania State Geology Department, the hard gneiss rock decomposed in some past geological age when it was at ground level and water leached through it over a period of thousands of years. The original gneiss rock contains quartz, mica and feldspar. The feldspar was hydrated during the leaching action and changed into kaolin, a white clay. Thus, this decomposed gneiss rock actually contains clay and will consolidate under load. On the approaches, this is not a serious matter, for the decomposed rock is overlaid with a sufficiently thick layer of compact sand and gravel to carry the light pier loads with very little settlement. Therefore, for the approaches, long continuous steel girder spans are used, founded on pile-supported piers.

For the main bridge piers, however, and especially the main piers at the river's edge, a special study was made of the effect of this 20-ft stratum of soft decomposed rock. This material has been found elsewhere in Philadelphia, for instance, in the foundations at the New Jersey end of the Tacony-Palmyra Bridge over the Delaware River, where it turned soft when exposed to water. It was also encountered in some of the caisson foundations of the Delaware River Bridge, where in some cases it held up the sinking of the caissons until excavation had gone 10 ft or more below the cutting edge, when it would suddenly flow, release, and drop a caisson. In the case of the Penrose Avenue piers, it was doubted whether, with the additional friction offered by the overlying gravel, it would be possible to sink the caissons through as much as 20 ft of this decomposed rock, and the underlying sound rock is so deep that it cannot be economically reached by the pneumatic process.

Main Piers in Open Caissons

Accordingly, it was decided to found the main piers at the river's edge at El. −65 in the compact sand and gravel overlying this decomposed rock. Some long-time settlement will occur on these piers, but much of what may be expected has already taken place during construction. The settlement of the main piers has been only $^{3}/_{4}$ in.

The caissons of these piers, which are large concrete boxes with steel cutting edges, were sunk by open dredging methods through sand islands. They are fairly heavy as such caissons go, yet it was almost impossible to sink the east pier caisson even as far as the proposed founding level of El. −65, and it was finally done only by intensive jetting for a

long period of time. The sand and gravel into which both main piers were sunk has a very high frictional resistance, and it is safe to say that these piers are held up partially by skin friction on the sides of the caisson, so that the pier loads are distributed by it over a very wide area of the lower decomposed rock.

Tunnel Crossing Investigated

As early as 1928 the need for a better facility at this point had become so apparent that a loan bill was passed by the City Council of Philadelphia providing a preliminary appropriation of $2,000,000 toward construction of a bridge or tunnel. In 1929, eighty wash borings to determine foundation conditions were made along a straightened alignment. These borings showed "mud" extending 75 ft in depth on the east side of the river, underlain by sand and gravel and finally by mica and what was called "churn rock."

Studies made for a tunnel as compared with a bridge showed that a bridge was less expensive. Both bridge and tunnel studies employed 4 percent approach grades, which at that time were considered acceptable. The 3 percent approach grades on the new bridge are based on studies of truck movements by the Public Roads Administration, which proved that on any grade steeper than this, truck speeds are so reduced as to seriously reduce traffic capacity.

It is of interest to cite several other features of the 1930 study as compared with the design finally chosen to show how traffic requirements have changed. Like the new bridge, the earlier project was to be four-lane, but the roadway width was 40 ft. The new bridge has four lanes at 12 ft each with a 3-ft dividing strip down the middle, so that the curb-to-curb width is 51 ft. The 1930 estimate of construction cost was $3,250,000; the actual bids, made in 1947 for the substructure, and in 1949 for the superstructure, totaled slightly over $12,000,000. The new bridge is wider, and because of the flatter approach grades, is also longer. The rest of the additional cost is accounted for by the changed value of the dollar.

Construction Financed by Federal Funds

The depression of 1930 prevented the financing of the bridge, which at that time would have been paid for entirely by the City of Philadelphia. Because of the certainty that a new bridge would eventually be built, the city wisely restricted the $2^1/_2$-mile-long right-of-way from all encroachments. Another delay was caused by World War II, but the need for the bridge became steadily more apparent because of traffic congestion on the existing route. Especially there was need for better access to the Philadelphia International Airport, which is only one mile from the west end of the new bridge and which is being expanded to make it adequate for the largest planes and suitable for an international terminal.

Financing of the project was finally assured in 1944 by passage of the Federal Highway Act, which made funds available for urban areas. An agreement with the Pennsylvania Highway Department was reached by which the city would pay for a preliminary report and for design plans and would furnish right-of-way, sewer and utility changes, and bridge lighting. The State of Pennsylvania would pay the cost of construction, using federal-aid funds. In 1944, Modjeski and Masters were engaged to prepare a preliminary report on the proposed Penrose Avenue Bridge. Following the presentation and approval of this report, the firm was retained as engineers for the design of the bridge structure and the connecting highways. Preliminary design of the project had to be approved by the Philadelphia Department of Public Works, the City Planning Commission, the Art Jury of Philadelphia, the Philadelphia Department of Wharves, Docks and Ferries, the U. S. Corps of Engineers, the State Highway Department of Pennsylvania, and the Public Roads Administration.

Approach Roadways

Except for the interchange at the east end of the bridge near 26th Street, the main roadways continue straight off the bridge to intersection near 26th Street with the existing dual concrete highways built by the state in 1942. As part of the project, the City of Philadelphia has constructed a 7-ft-high by 9-ft-wide stormwater sewer on the east side, paralleling the bridge. This sewer is founded on long timber piles.

In anticipation of future industrial development on the west side of the river, the right-of-way is being graded ready for side roads, and an interchange will be provided at the west end of the bridge to connect with the existing Penrose Ferry Road and future side roads. The main roadways are continued west as a dual highway with two 24-ft roadways to a connection with the Essington Avenue traffic circle, thus completing the uninterrupted four-lane route across the Schuylkill River in South Philadelphia which has long been needed and for which the access roads have already been provided.

Lights of Mercury Vapor Type

Bridge lighting is of the mercury vapor type, with horizontally burning 21,000-lumen lamps mounted 31 ft 9 in. above the roadway at a staggered spacing of about 130 ft. This will result in a maintained average lighting intensity in excess of 0.8 ft-candles. Each end of the bridge terminates in a concrete cellular construction which provides space for transformers to change the 2,300-v current to 240/480 for use on the bridge and approach roads.

Because of the proximity of the airport, red aerial obstruction lights are spotted on top of the lamp standards and trusses for much of the bridge length. The bridge was opened to traffic on September 12, 1951.

Modjeski and Masters were engaged by the Department of Public Works of the City of Philadelphia as engineers for the design. For the Department of Public Works, Thomas Buckley, M. ASCE, is director and A. Zane Hoffman is Chief Engineer. The bridge design was developed in cooperation with Mr. Buckley's department, largely through Samuel S. Baxter, M. ASCE, Acting Chief Engineer, and also in cooperation with the Pennsylvania State Highway Department through E. T. Baker, Chief Design Engineer, and L. A. Porter, Bridge Engineer, and with the Public Roads Administration. Construction was supervised by the Pennsylvania Department of Highways under the general direction of J. B. Shallcross, with E. S. Wallace as Resident Engineer. E. L. Schmidt is Chief Engineer of the Department.

Penrose Avenue Bridge Over Schuylkill River, Philadelphia, Pa.

Owner	City of Philadelphia
Designed by	Modjeski & Masters
Construction supervised by	Penn. Highway Dept.
Length overall	8,910 ft
Channel span	680 ft, cantilever
Anchor spans	Two, 340 ft each
Navigation clearance	135 ft
Height overall	200 ft
Roadway	3% grade, 52 ft wide
Foundations:	
Main piers	Open dredged caissons to El. −65
Approach piers	Reinforced concrete on concrete piles
Contractors:	
Substructure	Foley Bros., Inc.
Superstructure	Bethlehem Steel Co.
Total cost	$12,000,000
Design, right-of-way, lighting and services, paid by	Philadelphia
Construction, paid by	Pennsylvania Highway Dept., with federal aid

Can we get more engineers into public posts?

N. W. DOUGHERTY, M. ASCE

Dean of Engineering, The University of Tennessee, Knoxville, Tenn.

ENGINEERING college students have such full programs that it is a rare thing for them to take an active part in student affairs. The athletic teams, the debating society, the dramatic club and other such activities are passed by so that the embryo engineer may come to commencement day with the required average in his studies. Too often the meetings of his student chapter consist of just another lecture similar to the three he has already heard during the day, plus a short business session. The atmosphere of an engineering college campus is not too favorable for the development of extra-curricular activities.

This situation generally is not improved on the young engineer's first job, or on the jobs held during his first five years of practice. His work is often routine, and many hours of routine do not condition a person to be alert and active in civic life. A youngster has to be on his toes to make a place for himself in community affairs.

Of course the first responsibility of the engineer to his community is to be a good engineer. No matter how much may be said about civic mindedness, taking part in community affairs, and giving advice to the city council, the engineer's first task is to do the engineering work of the community with skill and efficiency. His job is to design, build and operate the utilities and industrial plants. It is his responsibility to furnish engineering knowledge to industry, transportation and communications. Any other activity is a supplement to this work and not a substitute. Only when he has fulfilled these primary functions should the engineer contribute to the non-technical life of the community.

In every city and community there are public works, building codes, transportation problems, safety controls, city planning and zoning, and a host of other matters that need technical study from the viewpoint of the citizen rather than from that of the specialist. These activities are often initiated and completed under the direction of lay committees or boards to whom specialists report. Engineers who are civic minded should take an active part in these deliberations. They do not need to be specialists in a particular field; their technical background enables them to make a vital contribution to the work of such bodies. Many civic activities introduce human as well as technical problems. Such problems often call for non-technical formulas for their solution—formulas based on give and take and sound common sense.

Constitutionally engineers avoid compromise. They know natural laws and they think quantitatively, in terms of precisely how much or how little. On the other hand, those who deal in civic and governmental affairs think qualitatively; they realize that practically every solution is a compromise. Historically perhaps the best example of a compromise is the Constitution of the United States. Nearly every leader present at the signing of this document was more or less dissatisfied with the final result, but each was willing to sign because he thought that it would be impossible to get agreement on a better document. The result was far better than any of the framers anticipated. It turned out to be a real solution to a very difficult and vexing problem.

"Compromise and Barter" in Public Life

Edmund Burke said, "All government—indeed, every human benefit and enjoyment, every virtue and every prudent act—is founded on compromise and barter." We engineers have difficulty in believing that compromise is needed, let alone barter. Our training and experience condition us to seek rigid solutions rather than flexible and elastic expedients.

Engineers are rarely elected to public office. In our city we have recommended an engineer for more than one public post and always without success. It is not enough to put an engineer in the running with the rest of the candidates. The sponsoring group must be willing to work for him as Bill Jones or Robert Smith, whose engineering ability is a special qualification. Many openings that could have been filled by an engineer to the advantage of all concerned, have been filled by others because the engineers did not get behind their candidate as an individual and sell him personally to the electorate.

Engineers' Functions Not Well Known

Too often the public thinks of engineering as a mysterious activity, too complicated for general understanding. Some engineers have promoted this attitude to the disadvantage of the profession. Most engineering is the application of very simple laws and techniques to elementary or complicated problems. Laymen generally are unfamiliar with these simple laws. Engineers should show the public the real nature of their activities and see to it that the public understands the functions of the designer and the constructor.

John Hancock is well known as a signer of the Declaration of Independence because he was willing to write his name first, and in such letters that the "King can read without his glasses." Most engineers are so modest that reporters have to pry information out of them. They act as though they were divulging state secrets rather than merely bringing the work of the profession to the attention of the general public.

The engineer has perhaps misread the article of his code of ethics which states that "He will not advertise himself in a self-lauditory manner" to mean that he will not advertise himself at all. There is a need for articles telling about engineers and their works, for short or long biographies showing what engineers have done for the community and the nation.

We cannot hide our light under a bushel and expect public appreciation. How can we serve unless we are called? How can we be called unless we are known?

Flat, eaveless

RICHARD R. BOYD,

OLD-TYPE PITCHED ROOF on 500-man barracks proved vulnerable to overloading caused by ice masses which thawed and refroze at the eaves. Also, condensation developed in attic space despite well-insulated ceilings. Building was designed by Fay, Spofford & Thorndike and constructed by Morrison-Knudsen Co., Inc.

FAMILY-TYPE STRUCTURE houses eight families. Exterior wall is finished with asbestos-cement shingles. Interior walls have gypsum wallboard finish with 4-ft plywood wainscott. Design was by Foss, Malcolm & Olsen and construction by S. Patti Construction Co. and MacDonald Construction Co., joint venturers.

NEW TYPE OF FLAT ROOF is receiving wide acceptance in Alaska, where snow is usually dry and blows off. Barracks shown are 200-man permanent type at Fort Richardson, designed by Pietro Belluschi and constructed by J. H. Pomeroy & Co., Inc.

FLAT ROOFS, without eaves and parapets and with inside downspouts, seem to be the best type so far designed for Alaskan buildings. High winds, heavy snow loads and extremes of temperature have proved the inadequacy of the conventional pitched roof in this area where climate is a formidable impediment to construction of all sorts. Weather in Alaska probably presents as great a range of elements as in any country on the globe. At the port of Whittier the mean annual snowfall is 182 in., and 105 in. have been recorded in one month. Whittier's annual rainfall is 181 in., while Anchorage, only 50 air miles distant, has an average of 16 in. yearly. Fairbanks, which is north of the Alaska Range, has recorded a high of 99 deg F above zero and a low of 66 deg F below. In the Aleutian Islands, the almost constant wind often reaches a velocity of 100 mph and occasional gusts reach 120 mph. The Panhandle, or Southeastern Alaska, has a mild climate with heavy rainfall due largely to the Japanese Current. These climatic extremes had to be considered in establishing building design factors.

All permanent construction, whether of monolithic concrete or concrete skeleton type with block panels, must be designed for earthquake resistance. Although intensities vary throughout the entire area, Zone 3 has been established as the force factor in structural design for the entire Territory, necessitating carefully designed crumble joints.

A critical housing shortage has existed in Alaska from the time military bases were established in 1941, and adequate facilities still fall short of the ever increasing needs for both military and civilian housing. Permanent-type housing for enlisted men and bachelor officers and permanent family-type quarters for military and civilian personnel are being constructed as fast as funds become available. Such housing constitutes

roof developed for Alaskan buildings

Architectural Engineer, Alaska District, Corps of Engineers, Anchorage, Alaska

approximately 26 percent of the 1951 building program.

Before 1949, when the first permanent concrete barracks for enlisted men were completed, troop housing consisted of two-story mobilization-type buildings, quonset huts, and other types of prefabricated units. The first of these permanent barracks, constructed at Fort Richardson and Ladd Air Force Base, had a steel skeleton with concrete walls, floor slabs, and fireproofing of the structural steel. Roofs were of the pitched type with standing-seam aluminum roofing. The attic space housed the ventilating equipment.

Flat Roof Has Various Advantages

Similarly arranged barracks now being built have been redesigned with a concrete skeleton, cement-block panels, and a flat-slab roof in order to reduce costs, expedite construction, and eliminate the icing conditions which develop at the eaves of pitched roofs. Partitions are 4-in. cement blocks. Exterior wall panels are 8-in. blocks with vapor-sealed insulation applied to furring strips, and gypsum board applied directly to the furring strips as the finished wall material. A wainscott of cement asbestos board 4 ft high is applied over the gypsum board for wall protection. Block partitions are finished only with paint. All floors are troweled concrete except toilets, wash and shower rooms, which are finished in tile. A rear wing of one story and basement houses the kitchen and mess hall on the first floor, and recreation facilities in the basement. The basement of the main building is largely for company storage and issue space.

The 1951 building program at Fort Richardson for family housing for both Air Force and Army includes eight-family units. The completion of these units as well as several large apartment buildings and housing developments in the city of Anchorage will greatly improve the quantity and quality of housing for both military and civilian personnel.

Before the 1951 program was inaugurated, all permanent housing was designed with pitched roofs. However, serious icing conditions developed on these roofs during the winter months, when alternate thawing and freezing cause ice to accumulate along the eaves. As the icing increased, shingles were ruptured and masses of icicles formed on the roof overhang, causing excessive loads and presenting the hazard of falling ice masses. Condensation developed in the attic space despite the well insulated ceilings below and gravity ventilation of the attic space.

As a result of these experiences, it was decided to change to a dead level roof, with inside downspouts and no parapet walls, on both concrete-slab and frame roof construction. In permanent construction, where concrete roof slabs are used, rigid insulation with the required U-factor is applied to the slab, and the built-up roofing is mopped to the rigid insulation. In frame construction, rigid insulation is applied to the wood roof sheathing, or blanket-type vapor-sealed insulation is stapled between the wood joists and the built-up roofing is applied directly to the wood sheathing. In the latter case the roofing must be laid dry on the sheathing, which is less desirable because of the lifting effect of the wind on a roof that is not mopped to the base material. Severe updrafts frequently occur near the foot of a mountain range.

This flat type of roof in frame construction offers many advantages in Alaska. A substantial saving in cost is realized by the elimination of attic or ceiling joists, rafter trussing, and asbestos shingles. With no parapet and only a cant strip to divert roof drainage from the exterior walls, there is usually sufficient wind to clear the roof of snow. The exception is at the port of Whittier, where the snow is often wet and heavy. Here a snow load of 100 psf is used in design.

The only local building materials are concrete aggregate, available in nearly all localities, and spruce lumber from the Panhandle section of the Territory. All other materials must be shipped from the West Coast and hence require rail and truck transportation from various points in the States, then transference to ships and barges. At Whittier and Seward, the only two ports with railroad connections, another transfer, to the Alaska Railroad, is necessary to reach the interior. Coast settlements on the Artic Ocean and Bering Sea and points on the Kenai Peninsula and in the Aleutian Islands are reached only by air and water. Sea lanes to the undeveloped harbors on the north coast are free of ice only for a short time during the summer months. With this wide range of climatic and subsurface conditions, earthquakes, transportation problems, and a short building season, provision must be made for a variety of design factors, types of construction and materials.

Smaller buildings such as the 40-room quarters for bachelor officers and the eight-family units are of frame construction with cement asbestos shingles as the exterior wall finish to lessen the fire hazard and reduce maintenance costs. Adequate insulation with an efficient vapor seal in the wall and roof framing is a necessity. The finish for inside walls and ceilings is usually gypsum board with a plywood wainscott 4 ft high for wall protection on stairways, in kitchens, and in vestibules. Plaster is not considered feasible from the standpoint of time and economy. Finished floors are linoleum, asphalt or rubber tile in kitchens and baths, and hard-wood flooring elsewhere.

Several types of prefabricated housing have been tried in an effort to economically expedite the program, but the results have been far from a solution.

ROBERT ZABOROWSKI, Jun. M. ASCE
Engineer-in-Charge, Roberts and Schaefer Co., Engineers,
New York, N.Y.

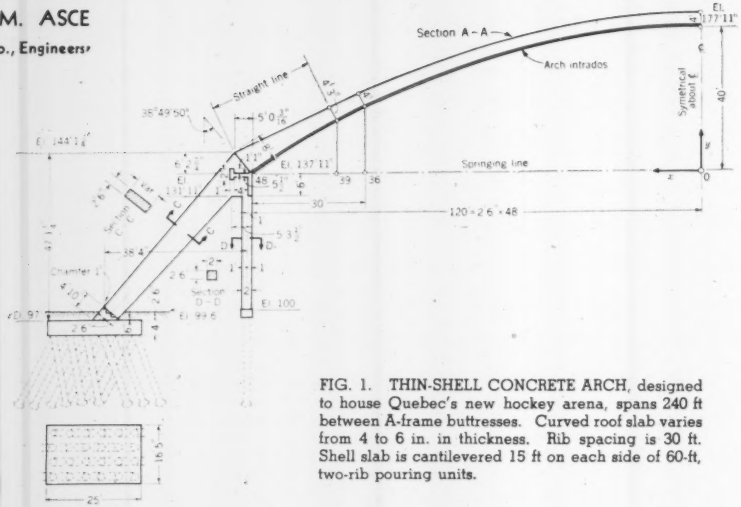
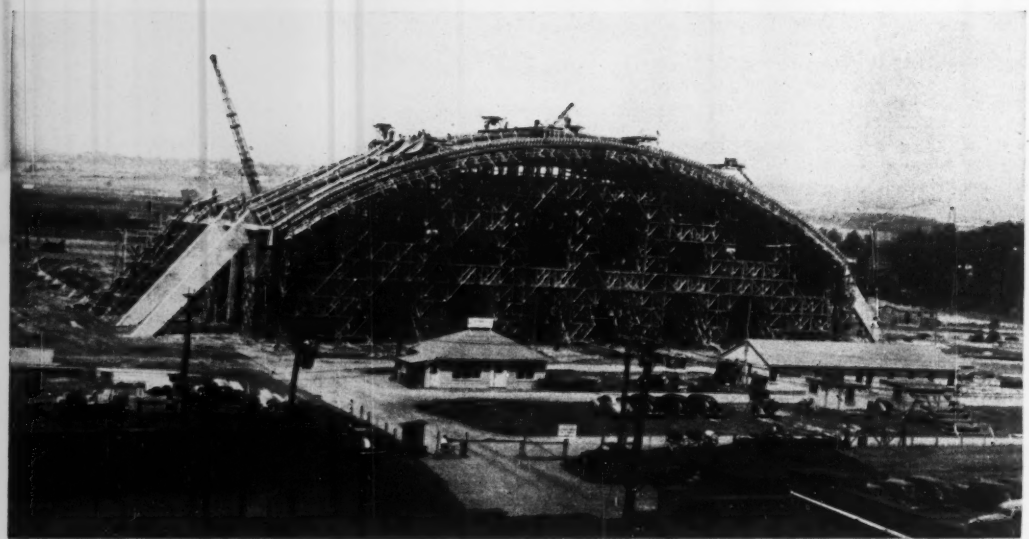
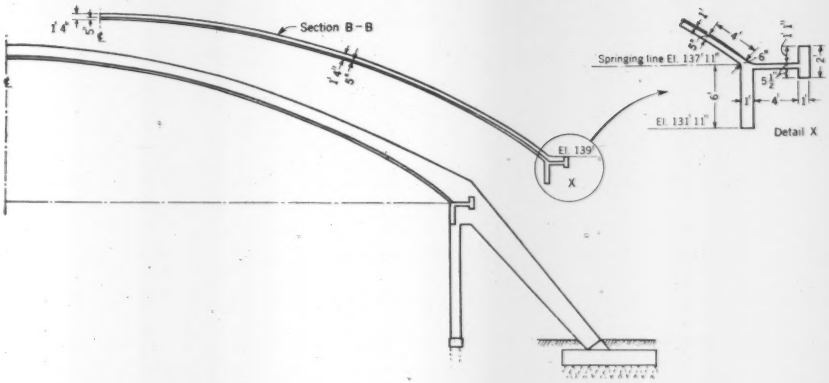


FIG. 1. THIN-SHELL CONCRETE ARCH, designed to house Quebec's new hockey arena, spans 240 ft between A-frame buttresses. Curved roof slab varies from 4 to 6 in. in thickness. Rib spacing is 30 ft. Shell slab is cantilevered 15 ft on each side of 60-ft, two-rib pouring units.

Thin-shell-arch hockey stadium for Quebec built in 10 months

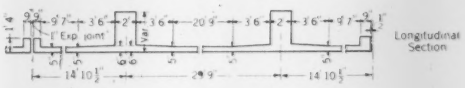


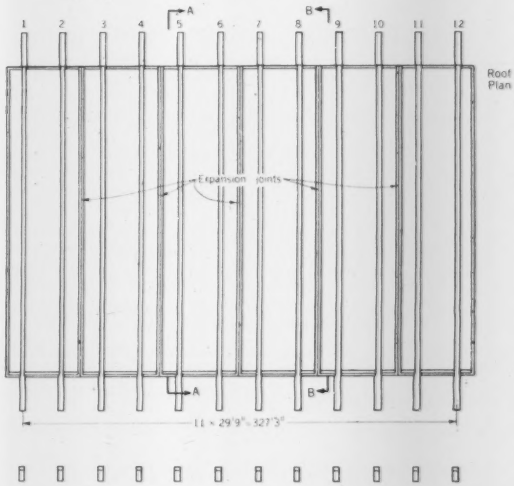


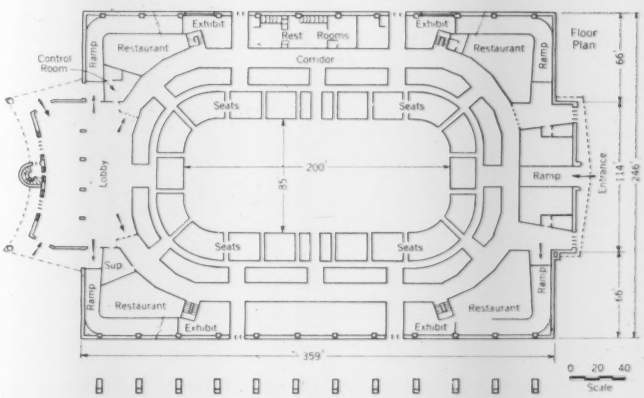
THE CITY OF QUEBEC wanted a new hockey arena, fireproof, capable of holding over 12,000 spectators—and wanted it by the date of the first home hockey game, scarcely 10 months distant. By December 15, 1949, the 240-ft, thin-shell-arch Quebec Colisée was open as promised.

True, the trades had not entirely completed their work, nor were the 10,500 permanent seats all installed. But the season's first hockey game was being witnessed by 5,000 spectators in the new arena, scarcely more than ten months after fire had gutted the old building. This is a significant achievement for a municipality of approximately 150,000 people. It is an unusual demonstration of teamwork on the part of the city fathers, the builder, the architect, and the engineer.

Two previous arenas had been destroyed by fire. The City of Quebec, Canada, wished to prevent this from happening again and at the same time to take full advantage of competition and technical progress. The bidding plans therefore prescribed only the functional requirements and stressed the need for rapid completion. The building had to provide permanent seating for 10,500 hockey spectators and space for 2,000 standees. Space for restaurants at each corner of the building was also to be provided, and ticket sales were

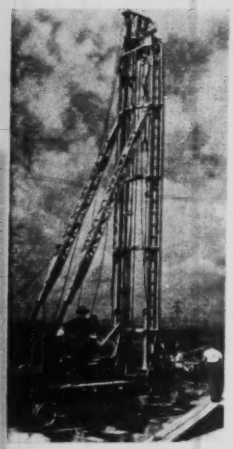






MOVABLE SCAFFOLD, consisting of braced towers, simple trusses, and birch-faced plywood, was used six times in pouring structure. Trusses were set on 160 five-ton jacks for decentering of form. Jacks, set at ground level, lowered entire falsework structure to light rails. Single crane winch pulled scaffold into next pouring position. Plan at right shows facilities for special exhibits and restaurants. Structure accommodates 12,500 spectators.

THIN-SHELL CONCRETE ARCH spans 240 ft across Quebec's new hockey arena. Each 60-ft. pouring unit consisted of two ribs, the included slab, and half of each adjoining slab. Arch-rib section of 4 x 2 ft is not minimum but was selected to permit rapid decentering of forms in cold weather, and because it required only normal field control of concrete. High speed of construction made these factors important.



SPECIAL PILE-DRIVING RIG forces dry concrete mix into previously driven steel pile shell. Pile shell is pulled as concrete is rammed down. These Franki piles were designed for maximum load of 60 tons in compression and 25 tons in tension.

to be conducted at each end of the arena. Corridors were to be wide, well lighted and suitable for temporary exhibits. The arena was to be equipped to handle all types of indoor activities with convenience and efficiency. A. Deslauriers et Fils, Ltd., submitted the low bid based on thin-shell-arch roof construction in reinforced concrete and guaranteed the earliest completion schedule—six months—for a structure equipped for partial use.

The ground-breaking ceremony took place on May 27, 1949. Simultaneously, the architects and engineers began their work: foundation and general structural designs in Montreal, superstructure design in New York, and architectural design in Quebec. Careful preliminary analyses of the shell roof and the seating structure permitted an early estimate of the requirements for reinforcing steel and the preparation of a shipping schedule for this material. Two weeks after the ground-breaking ceremony, the first caisson pile was driven. Considering that this was only the second such structure to be built in Canada, this early start was impressive.

The curved roof slab, varying from 4 to 6 in. in thickness, is supported by arches 4 ft deep and 2 ft wide, spaced 30 ft on centers (see Fig. 1). The arches have a span of 240 ft and are supported 40 ft above grade on A-frames. For convenience in pouring, the roof is divided into units 60 ft long, the shell slab being cantilevered 15 ft on each side of the two arches in each unit. About 400 cu yd of concrete was required for each roof pour.

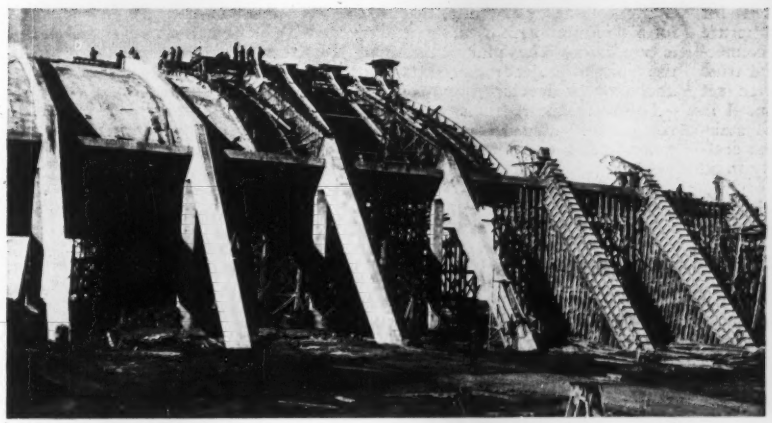
Shearing Resistance in Subsoil 800 psf

Soil explorations by the foundation engineers revealed a 22-ft surface layer of material consisting of a mixture of sand, silt, and clay with a shearing resistance of 800 psf. Sand and gravel were encountered below this layer, increasing in density with increasing depth. At 53 ft below grade, penetrometer tests showed zero penetration.

The maximum horizontal load on the foundation was 900 kips with a simultaneous vertical roof load of only 1,000 kips. The decentering operation, which is relatively quick, could be expected to load the foundations in a 30-minute period. Further, the foundations had to be sufficiently rigid to limit the horizontal movement of the tops of the A-frames to $^1/_2$ in.

The foundation engineers solved the problem with a system of vertical and battered caisson-type piles capped by a slab 25.5 ft long, 16.5 ft wide, and 4 ft deep. The analysis of pile loads was based on a condition lying between flexible piles with a rigid cap and rigid piles with a flexible cap. A maximum load of 60 tons was allowed for compression piles and 25 tons for tension piles. A total of 624 caisson piles were driven. Of these, 288 are in compression on a 25-deg batter; 96 are in compression on a 20-deg batter; 192 are in tension on a 25-deg batter; and 48 are vertical. These last were in tension just after the roof forms were lowered, but were finally in compression with the completion of the structure. These caisson-type piles have been tested to 200 tons without appreciable settlement.

The Franki caisson pile, heretofore not used in the United States but widely used on other continents, is produced by driving a casing to a bearing stratum. The casing is lifted a short distance and dry concrete deposited. A 3-ton drop-hammer with a fall of 20 ft rams the concrete into a bulb which simultaneously compresses the surrounding soil. The casing is then lifted in small increments and successive deposits of concrete are rammed into place, each deposit becoming trapezoidal in cross section. A careful record of A-frame



REINFORCED CONCRETE A-frames supporting thin-shell, ribbed arch, are sufficiently rigid to hold maximum deflection within $^1/_2$ in. when arch form is decentered. A-frame rests on pile foundation.

deflections, kept during erection, indicated that the foundations were behaving within prescribed limits.

Roof Designed as Thin-Shell Arch

The thin-shell-arch roof system was designed for the following loads: the dead load; a live load of 40 psf, distributed for maximum bending moment and thrust; an allowance of 10 psf for roofing and insulation; wind pressure based on a wind velocity of 100 mph; shrinkage equivalent to a 25-deg F temperature drop; a uniform temperature variation from +20 deg F to −50 deg F; a temperature differential of 20 deg F between A-frames and arches; and a temperature differential of 15 deg F between the arches and the shell slab. Allowance was made for a $^1/_2$-in. horizontal displacement of the arches at the tops of the A-frames. Secondary stresses due to arch deflection for several arrangements of loading were evaluated. Arch analysis took into full account the effect of rib shortening in the arches and A-frames. The maximum moments and corresponding thrusts in the arch ribs are shown in Fig. 2. The recommendations of the ACI were followed as a general design code.

Although the engineering profession was busy reexamining existing code provisions in the light of newly developed deformed reinforcing bars, the structural engineers for this project were confronted with the fact that deformed bars were unobtainable. Plain, smooth reinforcing had to be used throughout the structure.

The arch-rib cross section, 4×2 ft, is not a minimum limit from the point of view of stability. It was selected to permit rapid decentering of forms in cold weather and required only normal field control of concreting—both important economic considerations in view of the short time allowed for completion. Based on the designers' experience with such structures, the shell was attached to the arch intrados. This arrangement permitted quick decentering of forms with a minimum amount of jack manipulation and at the same time provided a pleasing unobstructed ceiling.

The most impressive component in the construction of a wide-span, monolithic concrete, thin-shell arch roof is the scaffolding. While there is no doubt that many types of satisfactory scaffolds could have been designed, the combination of braced towers supporting a system of simple trusses on screw jacks topped with a plywood skin on joists has repeatedly proved itself to be economical in both time and money. Even if the scaffolding were to be used as few as four times, the cost would be low enough to make this type of construction competitive with other systems of permanent construction. Actually the scaffolding in this structure was used six times.

A scaffold slightly longer than the 60-ft pouring unit was fabricated in the field and erected within five weeks. Ten transverse lines of 30-ft-span trusses supported the purlins and nine-ply, $^5/_8$-in., birch-faced ply-

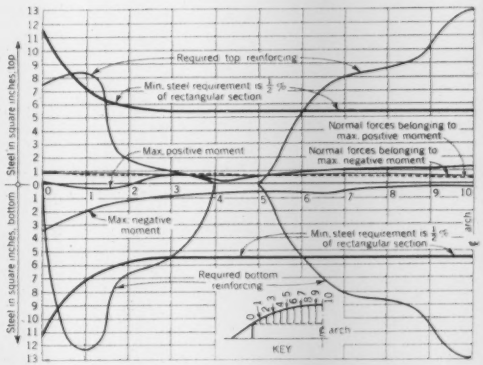

Steel in square inches, top
Steel in square inches, bottom
Required top reinforcing
Min. steel requirement is 1/2 % of rectangular section
Normal forces belonging to max. positive moment
Max. positive moment
Normal forces belonging to max. negative moment
Max. negative moment
Min. steel requirement is 1/2 % of rectangular section
Required bottom reinforcing
arch
KEY

FIG. 2. CURVES show maximum moments and corresponding thrusts for arch ribs. Arch analysis took into full account effect of rib shortening in arches and A-frames.

wood. Douglas fir was used for structural members and local spruce for bracing. Bolts and ring connectors were used for all tower and truss connections. The trusses were set on 160 five-ton screw jacks used in the decentering operation. A stairway and walkways within the scaffold afforded ready accessibility to all its parts. A finishers' platform was built at the rear of the scaffold, 6 ft below the ceiling, to permit any necessary touching up of the finished concrete while the scaffold was being moved into the next pouring position.

The tower posts each rested on wooden pads during the placing of steel and concrete. After decentering, the scaffold was lowered by jacks at ground level so that its wheels rested on light rails. A single crane winch was used to pull the scaffold into succeeding pouring positions.

Side forms for the arch ribs were fabricated in 8-ft sections. Precast concrete blocks were used to support the side forms the proper distance above the plywood deck. Side braces were similarly fixed to precast blocks.

Plain Bar Reinforcing Used

After the roof form was oiled, the reinforcing steel was placed. Since welded wire fabric was not available, individual bars had to be used on this project. Chairs were placed to insure the proper elevation of the various layers of shell steel. Diagonal bars, generally following lines of principal tension, were placed in the center of the slab. Bottom and top layers of transverse and longitudinal steel are required because of secondary bending moments in the slab produced by deflections. Generally, when deformed reinforcing is used, no bending is required. The plain reinforcing used for this project required that end anchorage be developed by hooks.

Steel for the A-frames was accurately fabricated in cages on the ground, and the stirrups were tack welded to insure rigidity. This proved to be an economical and satisfactory procedure.

Concrete was deposited by buggy over four runways, each 8 ft wide. Steel lined, oval-bottomed chutes were used to transport concrete without segregation to areas below the runways. Canvas was placed below all chutes to catch overflows or accidental spillage. Bottom-dump hoppers of 1-cu yd capacity were used at the end of the runways to load the 7-cu ft rubber-tired buggies.

A ready-mix concrete company three miles from the site supplied 45 cu yd of concrete per hour with eight transit-mix trucks. Two light cranes with 80-ft booms and 20-ft jibs, and one crane with a 100-ft boom lifted the concrete to the hoppers on the scaffold runways. The light cranes used $^1/_2$-cu yd buckets and the heavy crane a 1-cu yd bucket. All concrete was thoroughly vibrated with ten electric and four gas vibrators. Very little honeycombing was evidenced. The pouring time for each roof section was approximately 10 $^1/_2$ hours with an average total crew of 95 men.

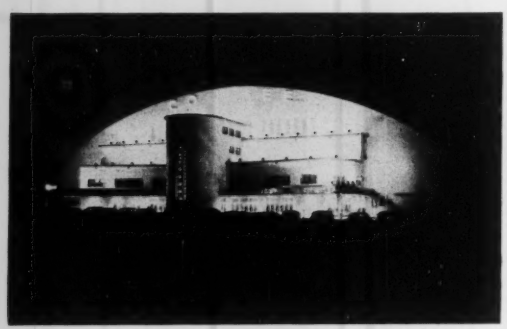
The time of decentering was established from field-cured cylinders and test beams. A minimum average cylinder break of 2,000 psi and an average beam modulus of elasticity of 2,000,000 psi were required. Sixteen men, one to a screw jack, following instructions over a public address system, lowered the forms in approximately two hours. The average time required for moving the scaffold into the next pouring position was one hour, depending on the extent of ceiling patching necessary. During this time workmen swept and oiled the form so that steel placement could begin as soon as the form was in position.

Approximately six sacks of cement, generally a high early strength type, were used per cubic yard of roof concrete. Slumps were not permitted to exceed 3 in. Air entrainment of from 4 to 6 percent was obtained by the addition of Darex. Roof concrete was cured by spraying a membrane curing compound over it.

The last roof pour was completed ahead of schedule, four months after the first pile was driven. By December 15 a total of 10,000 cu yd of concrete had been placed and 1,200 tons of reinforcing had been set in the foundations, superstructure, floor and seating. The general construction contract was awarded at a price of approximately $900,000. The City of Quebec was pleased with the appearance, inherent permanence and cost of this new arena as well as with the early completion date.

For the Quebec Stadium, Messrs. Caron and Rinfret were the architects; A. Deslauriers & Fils, Ltd., the contractor; and Truscon Steel Co., the structural engineers. Consulting engineers for the shell roof design were Roberts and Schaefer Co.; and the Franki Pile Co. of Canada was responsible for the foundations.

COMPLETED structural contract was for about $900,000. Ten months after destruction of old arena by fire, new fireproof structure was opened. Actual construction, from ground breaking to first home hockey game, was accomplished in about 6$^1/_2$ months. Although 10,500 permanent seats and interior finishing were not completed, promise to have arena ready for game was fulfilled. Last roof pour was completed ahead of schedule, four months after first pile was driven.



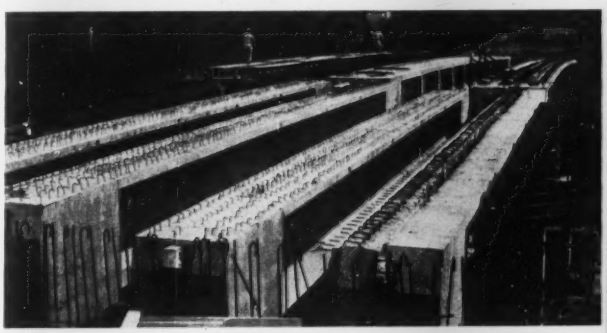
Why Prestressed Concrete?

LEO H. CORNING, M. ASCE, Manager, Structural and Railways Bureau, Portland Cement Association, Chicago, Ill.

RARELY is it possible for any of us to have a part in a major engineering development virtually from the start. Yet such an opportunity is now presented in the case of prestressed concrete. In making this statement I have not forgotten that prestressed concrete has been used successfully outside of this continent for many types of structures for a number of years by such pioneers as Freyssinet, Magnel, Hoyer, Evans and others. I also recall the contribution made by the Preload Company in this country in applying the principles of prestressing with high-strength wire to the construction of concrete tanks. I remember that the fundamental idea of prestressed concrete was first voiced as long ago as 1888 in the city of San Francisco.

Nevertheless, I believe that historians of engineering progress will consider the First United States Conference on Prestressed Concrete held at the Massachusetts Institute of Technology in August 1951 as marking the virtual beginning of the use of prestressed concrete by the construction industry in this country. What has gone before has established certain basic principles. The structures already built have proved those principles to be sound but there is still much to be learned. The work done so far has given us a strong foundation on which the superstructure of accomplishment can now be built. The period of greatest achievement lies ahead.

French, Belgian, German, Swedish, English and other engineers have made amazing progress in a relatively short time in developing and putting into use this essentially new material. The enthusiasm accompanying its spread abroad to many applications was referred to by Prof. R. H. Evans,



Bridge girders prestressed by Magnel's method

Concrete girders for Walnut Lane Bridge, Philadelphia, Pa., were prestressed by Magnel's method of stretching two wires at a time and wedging them in pairs in so-called sandwich plates. Above, prestressed girders are in place. At left below, one cable is being pulled through tunnel in girder, and at right below, prestressing is under way at an end anchorage. Design and construction of all prestressed concrete members of the bridge were by Preload Enterprises, with Henry W. Horst Co. as contractor.

M. ASCE, University of Leeds, when he said, "It is doubtful whether any development in civil engineering has been accompanied by so many lectures, demonstrations and exhibitions." (Research and Developments in Pre-Stressing, *Journal of the Institution of Civil Engineers*, No. 4, February 1951). It has also been said that the importance of prestressed concrete is overshadowed only by the original development of reinforced concrete.

Why has prestressed concrete attracted such attention abroad and why is much the same degree of interest being shown now in this country? The construction industry has often been accused—unjustly in my opinion—of backwardness, of over-conservatism. Architects and engineers are said to be traditionalists, slow to appreciate new ideas and put them into practice. On the contrary, I am convinced that no other industry has its feet so firmly on the ground. It does not follow a will-o'-the-wisp or take up with every new idea that is proposed by a zealous advocate, nor does it yield readily to pressure to reduce standards on the often fictitious argument that by doing so quality will be improved and cost reduced. On the other hand, when a type of construction is proposed which appears to have merit under the economic conditions of the time, there is avid interest in it and a determination to find out by study and actual trial whether the claims made for it are valid.

Three Basic Questions Asked

Some may say, "We have got along without prestressed concrete for a long time. Why has it suddenly become so important?" The answer to that question and to the question which forms the title of this article lies in the answers to three fundamental questions that apply to all types of construction. First, does prestressed concrete result in better structures? Second, is it more economical? Third, does it save critical materials in time of emergency or conserve natural resources over a long period?

Complete answers to these questions will not be found at once. They will only be found, in fact, after a long period of work in the laboratory, in the design office, and finally on the proving ground of competitive bidding, actual construction and performance. However, we can find answers that are sufficiently convincing to justify the attention now being given to prestressed concrete.

Dr. F. G. Thomas, in a monumental paper entitled "Prestressed Concrete," in the Proceedings of the Conference on Prestressed Concrete, published by the Institution of Civil Engineers in 1949, stated the basic principle of prestressing as "the imposition of preliminary internal stresses in a structure, before the working loads are applied, in such a way as to lead to a more favorable state of stress when these loads come into action." It would be difficult to improve on that statement as a simple yet comprehensive explanation of why prestressing results in better structures. Whether the structure is of wood, steel, concrete or other material, prestressing will be beneficial although the practical problem of imposing these preliminary stresses and the degree of benefit from their imposition may vary considerably with each material.

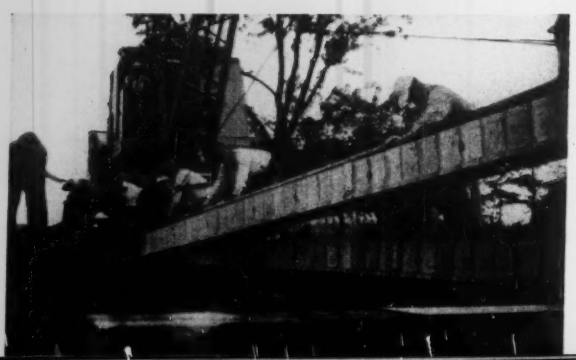
Because a prestressed concrete structure can be designed so that all the fibers in flexural members are under compression at all times under working loads, and even shrinkage cracks cannot occur, it does not necessarily follow that prestressed concrete members should always be used instead of conventional reinforced concrete members. A completely crackless concrete member is only better for a specific purpose if the presence of minute cracks is detrimental to its use. However, the very fact that concrete can be made completely crackless by prestressing makes it especially advantageous for positions of severe exposure.

To impose preliminary internal stresses in a concrete member, a high-strength steel must be used so that the loss in stress in the steel due to elastic and plastic deformations and shrinkage will be only a small part of the initial stress. Because of these stress losses in the steel, it is essential to use steel of high tensile strength if the benefits of prestressing are to be fully realized. By virtue of the fact that steel of high tensile strength is used, it is practical to provide great tension capacity in the member with a minimum cross-sectional area of reinforcement. Because of this high tension capacity, it is logical to use a concrete of relatively high compressive strength.

Just how high the strength of the concrete should be for greatest econ-

Bridge beams consisting of many precast units prestressed by Roebling bridge-wire strands

Beams for Madison County Bridge, Tennessee, seen in storage yard (above), consist of many separate hollow precast sections held together and prestressed by steel strands held by steel anchor plates and stud bolts. In view below, 30-ft beam is being set in place in bridge. Structure, completed in October 1950, was designed by Bryan and Dozier and built by maintenance forces under supervision of Ed Rogers, Madison County engineer.



omy and best performance under all conditions of loading is still a subject for study. Although concrete with a strength as low as 3,000 psi can be used satisfactorily, it has been established that a concrete strength from 5,000 to 7,000 psi generally can be used to advantage. Along with higher strength goes better quality and smaller sections, with correspondingly less weight and smaller forms.

It is worthwhile to consider a little further the possible benefits to be realized by so designing concrete flexural members that all fibers from top to bottom on every section are in compression, with the result that the members remain uncracked at the working load and at a reasonable overload. One benefit is simplification of design, because up to its cracking load a member acts as a homogeneous section, but for the moment we are concerned with the question of better structures and not with simplification of design. Because, in the absence of cracks, the entire cross section of the concrete is in compression, diagonal tension stresses are reduced. This condition permits a relatively thin web and makes possible the use of I- and T-sections. Such sections make the most efficient use of materials, so that greater loads can be carried over longer spans. By virtue of shape and homogeneity, loads can be carried with less deflection and members can be more slender, affording greater clearance. Furthermore, slenderness in engineering structures usually means better appearance just as it does in the human structure.

A much sought-for attribute in a highway or railroad bridge, and in most other structures for that matter, is maximum rigidity under working load accompanied by maximum flexibility under excessive overload to afford warning of impending failure long before it occurs. This is a quality readily produced in prestressed concrete by proper application of the basic principles of design. Up to the cracking load—which is normally considerably above the design load—and for some distance beyond, prestressed concrete members are more rigid than conventional reinforced concrete or structural steel members of comparable depth, but the prestressed concrete members will deflect like a sway-backed mule to give warning that they are overloaded before they fail altogether.

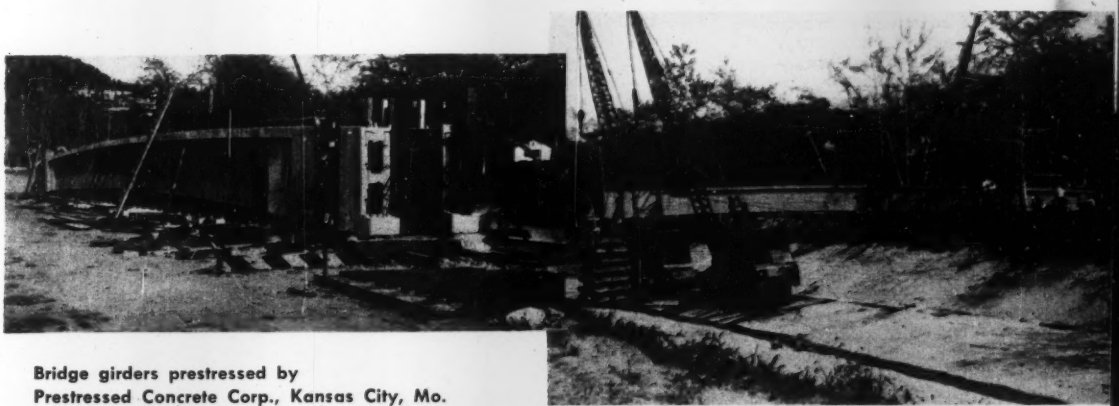
This characteristic of prestressed concrete is controllable by varying the degree to which the concrete is prestressed. Where safety against cracking is of the greatest importance and the possibility of overloading is relatively remote, a high degree of prestressing can be provided. The margin of safety between cracking and failure is then comparatively narrow. At the other extreme, for structures in which cracks at or near the working load are not objectionable, and where temporary overloading may be expected, or the structure must have the maximum capacity to resist severe shock without failure, the desired characteristics can be obtained by applying a smaller prestress. In this way prestressed concrete structures can be tailor made, as it were, to fit the conditions of the job.

Some of the reasons why prestressing should result in better structures can be summarized as follows:

1. Prestressing makes concrete crackless, which is conducive to greater durability under severe conditions of exposure.
2. Prestressing makes it possible to use efficiently concrete of higher strength and correspondingly better quality.
3. Prestressing makes it possible to use thin-web concrete members of I- and T-sections, thereby obtaining the most effective distribution of material.
4. Prestressing minimizes deflection and reduces the depth of beams and girders and the thickness of slabs, thus affording greater underclearance.
5. Prestressing results in maximum rigidity under working load and maximum flexibility under excessive overloads.
6. Prestressing makes it possible to design each structure to fit job requirements.

The literature is full of evidence that an affirmative answer can be given to the first of our basic questions, "Does prestressing result in better structures for many job conditions?"

But how about the second question, as to the economy of prestressed concrete? While the use of this material may be indicated under some conditions simply because it produces a better structure to meet those particular conditions, its general use will be dependent upon economy. American builders, being without extensive experience with this material, naturally turn to European experience for an answer whenever the question of economy is raised. Invariably, when they do so they are confronted with the tradition that materials are



Bridge girders prestressed by Prestressed Concrete Corp., Kansas City, Mo.

Two 110-ft concrete girders for Arroyo Seco footbridge, Los Angeles, are shown in view at left, cast but not yet prestressed. First step in moving one girder is almost completed at right, with end set on temporary support. Arroyo Seco Bridge was designed by Bridge Department of the California Division of Highways, and contractor was Walter Kaucher.

scarce and expensive over there while labor is cheap. In this country the opposite has been the case in years past. Hourly rates for labor in this country are very substantially above those abroad.

Here many trades are required to construct even a simple structure whereas in Europe the same man, figuratively speaking, often will build forms one day, place steel the next, and mix, place and finish concrete the next. Abroad the contracting organization frequently employs the engineer, supplies the design, controls the type of construction, and furnishes a complete job to meet the rather broad requirements of the owner. In general, that is not the situation here. We therefore cannot conclude that prestressed concrete will be economical here merely because it has proved to be definitely competitive with other types of construction in Europe. On the other hand, there are certain similarities between conditions here and abroad that cannot be wholly ignored.

Does It Save Critical Material?

The expansion of prestressed concrete abroad into an accepted and highly regarded type of construction can be attributed largely to the necessity for saving material during a wartime economy and for cutting the cost of construction as much as possible. In the United States we are in precisely that same situation today. Construction costs have mounted to the point where every expedient must be considered, and every new type of construction offering possibilities for economy must be thoroughly tried to determine its merits, if we are to continue the volume of construction required to meet the needs of our country. We can no longer be profligate of material simply to conserve labor.

It is easily demonstrated that the use of prestressed concrete for a member or structure will reduce the amount of concrete and reinforcement as much as 50 and 75 percent, respectively, as compared to the use of conventional reinforced concrete. An even greater tonnage of steel is saved when prestressed concrete is used in place of structural steel. In the case of a three-story building in Edinburgh, Scotland, of prestressed concrete, the total weight of steel required, including the foundations, was 210 tons as compared to the 950 tons that would have been needed for a structural steel frame. Obviously, with the smaller sections that are typical of prestressed concrete, there is less contact area in the forms. Because of the lighter weight and because precasting is closely associated with prestressing, less centering is required.

Thus it is seen that prestressed concrete makes more efficient use of materials, and an affirmative answer can be given to the third question, "Does it save critical materials in time of emergency and conserve natural resources over a long period?" This efficient use of materials is highly important and may even outweigh other considerations, but if it can be done at less cost it will make an even greater contribution toward the improvement of our construction economy.

The methods of prestressing used abroad, like so many other construction operations, have been developed around the use of hand labor. American engineers must combine their design skill and ingenuity with the resourcefulness and ability of American contractors to get things done in the least possible time and at the lowest possible cost if the full economy of prestressed concrete is to be realized.

This does not mean that we should ignore what has been done abroad, although sometimes a completely new and superior method, procedure or device will result when preconceived ideas are ignored. It seems wise, however, in applying prestressing to American construction conditions to take advantage of all that has been learned abroad if it can be fitted into our way of doing things. By careful study of the merits and shortcomings of the methods in current use, by modification to fit our conditions, and by the addition of wholly new ideas, not one but several American procedures may be developed. They will be keyed to our tempo of construction and to the relationship that obtains here between the costs of labor and materials. There appears to be no serious obstacle to the economical construction here of prestressed concrete structures for many purposes.

It would not have been unexpected if early experience in this country had shown prestressed concrete to be more expensive than conventional construction. Engineers, when designing in an unfamiliar medium, are inclined to be conservative, and properly so. Contractors, when called on to bid on a type of construction with which they have had no experience, have no yardstick of unit prices. Their job costs frequently run high until the supervising personnel and the men actually doing the work learn the most efficient way of doing things. In the case of prestressed concrete, however, this inexperience and unfamiliarity have not resulted in higher costs but on the contrary, to the best of my knowledge, on the few jobs thus far built in this country, equal or lower costs have been reported as compared with other types of construction. It has also been said that, in some instances at least, further savings could have been realized by refinements in design.

Only time and experience will fully establish the relative economy of prestressed concrete. In other innovations such as the hollow-girder reinforced concrete bridge used by the California Division of Highways, the cost has steadily declined as the designers have found out what they can do with it and the contractors have become familiar with the construction. There appears to be every reason to expect a similar drop in cost with prestressed concrete.

Thus far I have been speaking of economy in the structure itself. Important as that may be, there are associated economies in such cases as railroad grade separations and traffic interchanges on express highways that may exceed the saving in the prestressed concrete structures. A few inches—sometimes it may be a foot or more—saved in the deck depth of a bridge will result in a lower cost for retaining walls, fills, drainage, approaches, right-of-way, connecting trackage (in the case of railroad structures) and other appurtenant works. Such savings can be of very significant proportions. Therefore in any study of the economy of prestressed concrete, the entire project should be considered and not solely the particular part in which prestressing is used.

Design Specification Needed

The full economy of any type of construction is never realized until a design specification or code of practice is available for the guidance of designers. As yet there is no recognized specification for prestressed concrete in this country. For this reason many engineers will be hesitant about undertaking a design. As long as this situation continues, the number of minds in the office and in the field at work on the development of improved prestressed-concrete design and construction methods, keyed to our American economy, will be greatly limited. To set up design and construction specifications from scratch for a particular job, as was done by the California Division of Highways for its prestressed footbridge over the Arroyo-Seco in Los Angeles, is far beyond the scope of

Prestressed beams for a grandstand

Masonry piers for Fayetteville, Tenn., grandstand are seen behind beams, which are being assembled and prestressed. Design was by Bryan and Dozier and prestressing was by Roebling bridge-wire strands. Structure was completed in 1950.

the average consulting engineer's organization.

Notably in France and Belgium, two engineers and their respective organizations very largely dominate the field of prestressed concrete construction. They can in effect set up their own standards with the result that specifications prepared by a national code-writing body may not be missed. Such a situation is, of course, inconsistent with the American way of doing business, where every qualified engineer and contractor feels that he should be free to engage in any kind of construction he likes so long as he meets recognized specifications.

It is important that such a specification be made available for prestressed concrete as soon as possible. Such a code of practice in its first draft should set up broad requirements which will insure safety without undue restrictions. Under no circumstances should such a specification prescribe methods of construction that will stifle development.

It is realized that our experience with prestressed concrete in this country is limited. We have a very great deal to learn but such was also the situation back in 1909 with respect to conventional reinforced concrete when the National Association of Cement Users, now the American Concrete Institute, came forth with the Report of the Committee on Reinforced Concrete. That report was, in effect, the first ACI Reinforced Concrete Building Code Requirements. The writing of that early design specification for reinforced concrete was a stimulant for development and progress. The ACI code has appeared in many completely revised editions, and in practically every year since the initial writing, changes have been made as growing experience and knowledge have indicated they should be. The same may be expected of prestressed concrete specifications for many years to come.

If there should be any question of the possibility of restricting progress by issuing a tentative design specification for prestressed concrete in the near future, we should consider the point made by Prof. Hubert Rusch concerning the German Design Specifications for Structural Members in Prestressed Concrete (7th Edition, January, 1950), as follows:

"The fears of various engineers that the preparation of these specifications would hamper free development have proved entirely without foundation. The intensive preoccupation of the committee with the variety of problems presented by this new method of construction has helped to elucidate many points and has, in many cases, stimulated the desire for new knowledge. It can be said without exaggeration that the great progress which has been achieved in the field of prestressed concrete in recent years would hardly have been possible without this work."

The situation in this country now is almost identical with that in Germany in 1943, when the Select Committee on Reinforced Concrete began preparation of the specification referred to by Dr. Rusch. An ACI committee has already been appointed to develop a design procedure and specification. If this is done now I believe that six or seven years hence we shall be able to look back on a period of great progress in prestressed concrete design and construction. I am also confident that this type of construction will have become much more economical because, with a specification to guide them, more and more people will apply their talents to its development.

Evidence Favors Its Use

In the light of evidence now available, it is evident that this new material can be adopted in American construction practice with confidence that it will result in better structures under many conditions of service; that it will prove to be competitive with other types of construction and will frequently effect substantial economies; that under existing world conditions, it will enable us to channel a large part of our critical materials where they are urgently needed; and finally, that it will conserve our natural resources, which we are beginning to realize are far from inexhaustible.

Surely, with the worthwhile work already accomplished and with the influence of the First U. S. Conference on Prestressed Concrete, a substantial beginning has been made in fitting prestressed concrete into our American construction economy. Let us not in our enthusiasm make the mistake of trying to apply it where it does not belong. Let prestressed concrete be used wisely and judiciously. Considered decisions, careful design and construction in the best American tradition, will result in structures that will serve mankind better and more efficiently.

(This article is based on the paper presented by Mr. Corning before the First U. S. Conference on Prestressed Concrete at M.I.T., Cambridge, Mass., August 14-16, 1951, of which ASCE's Structural Division was one of several sponsors.)

Building with prestressed beams and girders

For Midwest Geophysical Research Laboratory, Tulsa, Okla., 30-ft prestressed beams were placed on prestressed girders. This building, completed in 1951, is one of first in this country to incorporate prestressed members. For part of building shown here, John A. Roeblings' Sons Co. furnished prestressing strands and end connections. Contractor was P. F. Blair & Son.

Is the growth of our cities properly guided?

HARLAND BARTHOLOMEW, M. ASCE, City Planner, St. Louis, Mo.

AFTER some thirty-five or forty years of talking about plans for American cities, are we producing the good city plans that are required? Is the total development and growth of American cities being directed in accordance with well-designed city plans? At the risk of being charged with pessimism, I must say that it is doubtful if these two questions can be answered affirmatively. There are, however, a few notable exceptions.

One explanation of our failure in this direction is that we have become so interested in several parts that we have lost sight of the total objective. We have become so interested in *planning* that we have failed to produce good *plans*. Planning for planning's sake is only a pleasant pastime. Any city plan that is not definite, detailed and official will not permit the necessary coordination of the many individual buildings, sewer lines, parks and schools as each is built. The city of the future is being built today—by the addition of these many small parts, each of which can be expected to last for several decades. The effective city plan coordinates the design of each of these before it is built.

Zoning Ordinance Is Not a City Plan

Have we not been content with too many "outline" plans? And have we not fallen into another error of preparing a zoning ordinance or major street scheme and deluding ourselves and the public with the belief that this is a city plan?

There are several points of view about city planning. The civil engineer sees mainly the water supply system, sewers, utilities, streets, transportation facilities and terminals. The sociologist is concerned with housing, population density, parks and recreational facilities. The architect is interested in buildings (public and private) and the open spaces which provide a good setting for them and supply the needed light and air. The economist looks at trends in employment and volume and types of business and industrial activity without which the city could not exist. These interests are not mutually exclusive, nor need they conflict. A good city plan synthesizes them all.

American cities have grown rapidly in recent decades, and technological changes occur with increasing frequency. There also have been marked changes in concepts of social welfare and in both national and local economy. Thus the science and art of making city plans have become more complex. But this fact only emphasizes the need for greater effort and higher skill in the production of such plans.

Selection of Subjects Is Initial Step

The initial step is to prepare a list of subjects which will comprise the comprehensive city plan. (See box for a suggested list.) Each subject should be the subject of a special report. Decision should also be made as to the time required to complete the plan. This will normally vary from two years for small cities, to three or four for larger cities. Over a period of three years, for example, this means the production of a special report approximately every two months.

Responsibility for preparation of the plan rests squarely on the shoulders of the city plan commission, which should devote itself almost exclusively to this work, and after its completion, to the administration of the plan. Since the plan should be a dynamic instrument, the commission should also carry on studies looking toward its periodic review and revision.

In most cities the members of planning commissions are citizens giving voluntary part-time service, plus certain administrative officials in responsible charge of public work of a planning nature. Since most of the members of the commission have limited time and seldom have technical city planning training, it is the duty of the staff, under competent technical direction, to prepare the first drafts of the reports—for review by the commission prior to publication as preliminary reports. Following publication, the preliminary reports should be furnished to various organizations and groups and widely publicized in other ways.

A MODERN CITY PLAN may consist of some 16 specific subjects under three main heads:

I. Research and analysis
   1. Historical background
   2. Site characteristics and development
   3. Social and economic characteristics
   4. Population growth, density and distribution
   5. Land use

II. Physical improvements
   6. Major street plan (including offstreet parking and land subdivision control)
   7. Local transit facilities
   8. Transportation—rail, water and air
   9. Water supply, sewers and drainage
   10. Park and recreational facilities and public schools
   11. Zoning
   12. Housing
   13. Public buildings and publicly owned lands
   14. The city's appearance

III. Ways and means of carrying out the plan
   15. Administrative policy and practice
   16. Capital expenditure program

Special problems in some cities may justify departures from this list.

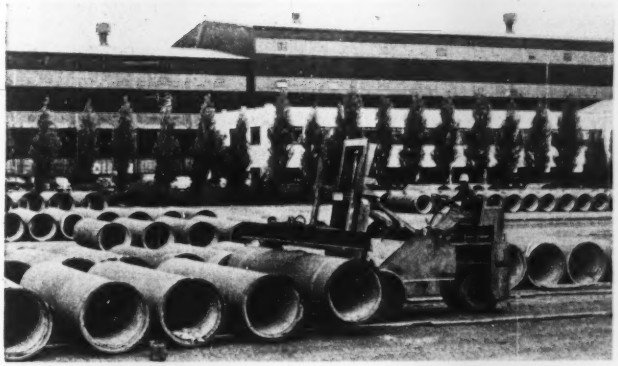
Importance of Formal Adoption

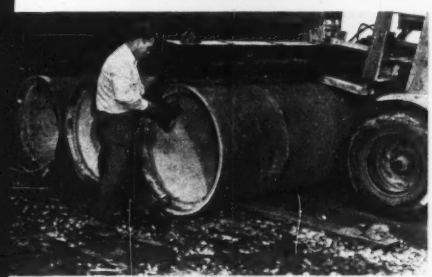
Finally, after full discussion and after public hearings—required in most states—the various preliminary reports should be consolidated and the plan should be formally adopted by the planning commission as the official comprehensive city plan. Without such formal adoption a plan will not be much more than another brochure about the city, and it will not receive the necessary recognition by the courts.

The official plan should be published in attractive and substantial form and widely distributed. It should be a handbook easily and quickly referred to by the many individuals, organizations and agencies, both public and private, that are making improvements, designing buildings, investing money, or making other decisions that affect the development of the city. Only in this way can the required coordination be obtained so that all can participate in the exciting task of building a better city.

(This article is based on Mr. Bartholomew's paper read at the April 1951 Citizens National Planning Conference in Miami, Fla.)

Simple device equips fork-lift truck to yard concrete pipe sections





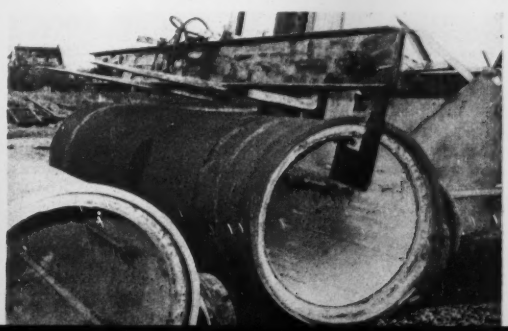
FORK-LIFT TRUCK equipped with I-beam and hook pickup moves prestressed concrete and steel-cylinder pipe from curing bins to storage yard. Two men are required—one to drive truck and one to operate pickup. Best previous method required eight or nine men to roll pipe on planks. Other methods tried were either too slow or caused excessive damage to pipe.

EACH PIECE of prestressed concrete and steel-cylinder pipe must be handled six times during manufacture at the Rochester, N.Y., plant of Price Brothers Co. New methods have recently been developed to cut costs and time in these handling operations.

The first step in making this pressure water pipe is the forming and testing of a steel cylinder, which is then placed on end while a concrete core is cast inside it. Next the steel-in-concrete pipe is lowered to a horizontal position and wrapped with high tensile steel wire which prestresses the steel cylinder and the concrete core. Later a protective coating of mortar is applied, followed by steam curing. A single railroad crane handles the pipe between all these processes of manufacture.

After the pipe is manufactured, there is the problem of moving it from the curing bins to the storage yard. When finished, each piece is 16 ft long, 48 in. in inside diameter and weighs approximately $6^1/_2$ tons. Many methods have been tried but all except that here described were either too slow or resulted in too much damage. The best previous method was the old fashioned one of rolling the pipe across the yard on planks by hand labor. This process took eight or nine men. Now the job is done with two men and a fork-lift truck plus the simple I-beam and hook pickup shown in the accompanying photographs.

IRON PIN on I-beam secures hook in open position (below, left) as well as in closed position (below, right). Entire hooking assembly can be removed from fork of truck in a few minutes. Rubber bumpers used to protect pipe appear below, left.



ENGINEERS' NOTEBOOK

Drawdown in artesian wells computed by nomograph

VEN TE CHOW, Assoc. M. ASCE, Department of Civil Engineering, University of Illinois, Urbana, Ill.

IN DEVELOPING ground-water resources by pumping from artesian wells, modern engineering practice requires the computation of drawdown in the well or wells located within the area of the pumping field, at the end of a given pumping period, caused by the discharge of the pumped well from an areally extensive water-bearing stratum. The equation commonly used for this computation in engineering offices is the non-equilibrium equation presented by C. V. Theis in his paper, "The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage (American Geophysical Union, *Transactions*, 1935, pp. 519–524):

$$s = \frac{114.6\,Q}{T}\int_u^\infty \frac{e^{-u}}{u}\,du, \text{ in which}$$

s = drawdown of water level in the observation well or any observation point in the pumping field under consideration, in ft

Q = constant discharge of the pumped well, in gal per min

T = coefficient of transmissibility, in gal per day per ft, characterizing the ability of a water-bearing stratum to transmit water under a unit hydraulic gradient

e = base of natural logarithm, or 2.7183...

u = an argument $= \dfrac{1.87\,r^2S}{Tt}$

where

r = distance of the observation well, or any point in the pumping field under consideration, from the center of the pumped well, in ft

S = coefficient of storage, as a ratio or fraction, indicating yield of water from storage in the water-bearing material under a unit decline in head

t = time since pumping began, in days

The values of T and S are known as formation constants of the water-bearing stratum, and can be determined by a pumping test. The computed drawdown is due to the pumping of one well. When several wells are operated at the same time, the total drawdown in the observation well or at any point in the pumping field is equal to the sum of the drawdowns caused by each pumped well.

Solution of the non-equilibrium equation is not easy because of its exponential integral form. The nomograph presented here as Fig. 1 was

THE READERS WRITE

Reclassification of Engineers in Government Service Considered Vital to Defense Effort

TO THE EDITOR: It is appropriate to call attention to a problem which concerns both the well-being of the engineering profession and the effectiveness of our rearmament program. I refer to the methods and standards for classifying professional engineers in the U.S. Civil Service. The general method of examining, grading, and classifying applicants is as follows:

1. Applicants for the lowest professional grade (formerly P1) are required to have a B.S. degree in engineering from an accredited college or the "equivalent in experience," and to pass a written examination.

2. Applicants for professional grades above P1 must have the same educational or experience qualifications as required for P1, plus one year of experience in each intervening grade. They are seldom required to pass a written examination, usually being graded entirely on the statements made in the application Form 57. Even in the case of an applicant for a higher grade who has never previously passed a written examination, the grade and classification are based entirely on his Form 57.

It can be seen that this method of determining qualification is subject to wide variations in both the light in which the applicant presents his experience, and the standards of evaluation by the examining board. Further, there is no basis for verifying the accuracy of claims made, or the manner of performance of duties, except by contacting former employers. I feel quite sure that such contact is very seldom made, except where positive doubt exists. In most cases, the memory or records of former employers or immediate superiors would be inadequate either to confirm or to deny any claims made as to services several years old, even if such an effort were made. It is therefore evident that the present method is very loose and susceptible to both honest error and deliberate abuse.

Even in cases where the type and grade of experience are accurately presented, there are many cases of laxity in interpreting "equivalent experience." This has been true in cases of my own knowledge, where two years of non-technical junior college training plus two or three years of surveying experience have been accepted as the equivalent of a B.S. degree in civil engineering. Such cases are most prevalent, I believe, where employees currently serving in subprofessional positions are sponsored for promotion by their superiors, and rated by the local examining board, which may include associates of both the sponsor and applicant as members.

designed to simplify the computation. The use of the nomograph is illustrated by the following example.

Example: Given the formation constants, $T = 84{,}000$ gpd per ft, and $S = 8.2 \times 10^{-4}$. A well is pumped at a constant rate of 150 gpm. It is required to compute the drawdown in a well 840 ft away from the pumped well at the end of 6 months of continuous pumping. The computation of the drawdown proceeds as follows:

Draw line (1) connecting $t = 183$ days on the t-scale and $S/T = 9.8 \times 10^{-9}$ on the S/T-scale. Draw line (2), parallel to line (1), from $r = 840$ ft on the r-scale to meet the right side of the S/T-scale at 9.0. Locate 9.0 on the s-scale as indicated by line (3). Draw line (4) connecting the value of 9.0 on the s-scale and $T = 84{,}000$ gpm per ft on the T-scale. Draw line (5) from $Q = 150$ gpm on the Q-scale and parallel to line (4). This line intersects the s-scale at $s = 18.5$ ft, which is the required drawdown.

The nomograph here presented was developed by the writer in response to a need he experienced when investigating ground-water problems at the Engineering Subdivision of the Illinois State Water Survey, of which H. E. Hudson, Jr., M. ASCE, is head.

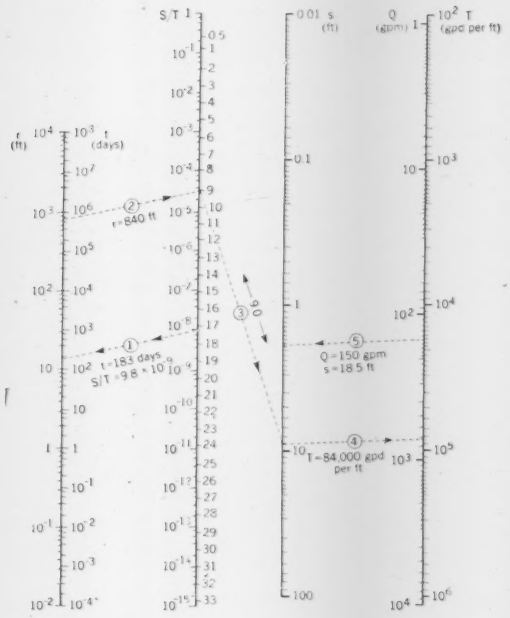


FIG. 1. NOMOGRAPH gives drawdown in well caused by pumping for given period at given rate in another well or wells located within area of pumping field in same water-bearing stratum.

The end product of this system is the P6, drawing $7,200 a year plus retirement and leave benefits, in responsible charge of important engineering design and construction, supervising well qualified civil, electrical, and mechanical engineers, and yet unable to pass the simple examination required for the rating of P1 engineer. This is of course contrary to the original concept of the graded civil service, which was conceived as an agency to staff the government service on the basis of proven ability by competitive examination.

Some of the major causes of this unwholesome situation may be traced to the rapid expansion during the last war, when standards were lowered because of the shortage of technical personnel and in order to compete with war industries. The effort to reestablish standards after the war generally resulted only in confirmation of the status quo. People who had performed subprofessional work under professional titles received credit for professional work, which led to their permanent appointment to professional grades.

In seeking a remedy for this situation, certain problems must be resolved:

1. Difficulty in determining qualifications accurately. For instance it might be impractical to attempt to prepare a comprehensive examination for each grade in each branch of engineering.

2. Disposition of incumbents who are not properly qualified.

3. Organized opposition from affected employees, and in some cases from their supervisors.

4. Possible difficulty in filling professional positions that might be vacated by reclassification of incumbents.

The solutions to these problems, however, can and should be found. The matter is of sufficient importance to merit serious study by the engineering societies and the government. In order to keep this criticism constructive, the following are suggested as possible solutions:

1. A return to written examinations is strongly urged as at least a prerequisite for employment by the government as an engineer. Certainly it would not be too difficult to administer the current P1 examination as a prerequisite for appointment or promotion to any of the first three professional grades. That would be a much more reliable method of establishing "equivalent experience" than the present method of evaluating the applicant's claims to experience. An engineer seeking appointment or promotion to the grade of P4 or higher, should possess the qualifications generally required for professional registration. A certificate of registration obtained by passing a written examination should be required, or in lieu thereof, successful completion of a similar examination conducted by the Civil Service at no expense to the applicant. The cost of preparing and administering these examinations would be negligible compared to the money saved as a result of eliminating incompetents from highly paid positions.

2. In disposing of unqualified incumbents, we must recognize the government's obligation to the taxpayers and to the nation's security, which depends on the skill of thousands of engineers in the employ of the armed services. There is certainly no obligation to support subprofessional people at professional salaries. As the very minimum, it is proposed that all engineer employees be given 12 months in which to qualify themselves in their current grade. Those who fail to

so qualify should be reclassified to a job description which fits the work they are doing.

3. The problem of opposition should be met with the same sense of responsibility as the problem of reclassification, but would require definite measures to insure that such opposition would not abort the process of reform. It is suggested that the examination and evaluation of professional employees be delegated no lower than the regional office, to insure uniformity of treatment.

4. Regarding the problem of filling positions made vacant by reclassification, the following observations are submitted:

(*a*) The reclassification process could not remove any actually qualified engineers, and would merely reclassify subprofessionals to a more accurate classification. The total volume of professional effort would not therefore be reduced.

(*b*) As the demand for more engineers arises due to expanded rearmament operations, the money saved by reclassification of large numbers of subprofessionals could be used to employ more engineers. If competition for engineering services increases, it may be necessary to raise salaries, but no good end is served by merely lowering classification standards. The total expenditures would be no greater if the pay scales were raised than if people were merely promoted to a higher grade than their abilities justify.

In summary, it is felt that a very definite and serious problem exists wherein the government employs non-engineers as engineers and entrusts them with the design and execution of engineering works which represent both large investments in funds and an important stake in our national security. It is imperative that these incompetents be speedily removed from positions of professional responsibility so that they will present no further obstruction to the speedy, effective, and economical prosecution of our rearmament program.

The legal basis for the necessary action exists in the civil service laws, if properly implemented. The major step required is the qualification of engineers by written examination as opposed to evaluation of unconfirmed claims. The large number of people now employed as engineers by the government certainly justifies the effort and expense required to stimulate such action, and it is a duty of the engineering profession to furnish the stimulus.

CHARLES B. PEKOR, Assoc. M. ASCE
San Francisco, Calif.

Mechanical Shear Connectors Recommended for Composite Action

TO THE EDITOR: In the article, "Can Reliance Be Placed on Natural Bond Between Concrete and Steel?" (July 1951 issue, pp. 42–43) Mr. Blumenschein raised an important question which should receive the full attention of bridge designers, specification writers, and research workers. The problem of the shear connection for a composite steel and concrete T-beam has been studied extensively at the University of Illinois as part of a research project sponsored by the Illinois Division of Highways and the Bureau of Public Roads. The results of these investigations will be published soon in two bulletins of the University of Illinois Engineering Experiment Station. The following comments on Mr. Blumenschein's paper are based on that work.

One of the characteristics of a composite T-beam is its great toughness. After yielding takes place in the steel, a composite T-beam undergoes large deflections before the ultimate load is reached and crushing failure of the concrete slab occurs. It has reserve strength several times greater than that for a corresponding noncomposite beam. The tests have shown that the concrete slab when connected to the beam resists the large rotations that tend to occur when the steel beam has yielded excessively. As a result, large stresses are introduced between the slab and the beam at those sections where the steel beam has yielded. These large stresses will undoubtedly initiate failure of the bond and with it a permanent loss of composite action. On the other hand, a good mechanical shear connection will insure that a composite beam remains composite at all stages of loading.

Whether it is sufficient to provide for composite action only at working loads, or perhaps up to yielding of the I-beam, or whether steps should be taken to assure full composite action at the ultimate load in flexure is, of course, a question of design philosophy. Although it might be possible to maintain the bond between the beam and the slab at working loads, if this bond is lost for any reason, it is gone forever; the shear connection vanishes, and the composite beam becomes noncomposite.

A beam designed on the basis of composite action has a smaller cross section than one in which the steel beam is designed to carry the entire load. Thus the loss of bond will result in a serious permanent lowering of the factor of safety. The writer believes that under these conditions a more satisfactory structure will result from the use of mechanical shear connectors rather than from relying on the bond alone. In this manner the designer will stay on the safe side and at the same time the structure will gain the additional toughness and reserve strength possessed by a beam which maintains full composite action up to the ultimate load.

IVAN M. VIEST, Jun. M. ASCE
Dept. of Theoretical and Applied Mechanics, Univ. of Illinois
Urbana, Ill.

Minneapolis Garages Cost About $1,000 per Car Space

TO THE EDITOR: On page 69 of the August issue you have a cut and a brief description of the two parking garages being constructed in Minneapolis, Minn. The one at 4th and Marquette will be opened for business tomorrow (August 22, 1951). The other should be open in about six weeks.

You give the cost of the two as $4,000,000. This is a serious error. The two structures, which have a capacity of 1,355 cars, are costing less than $1,000 per car space, exclusive of land. I am not familiar with the cost of the land, but understand that the total investment in buildings and land is about $2,000,000.

As my "smooth ceilings" system of flat-slab construction is being used in these structures, this correction should be published.

WALTER H. WHEELER, M. ASCE
Consulting Engineer
Minneapolis, Minn.

Architect on Delaware Memorial Bridge Credited

TO THE EDITOR: Full credit has been given to all engineers, consulting engineers and contractors connected with the Delaware Memorial Bridge in your story in the September issue, page 69. However, no credit was given to A. Gordon Lorimer, consulting architect of New York, who was responsible for the fine proportions of the bridge towers, piers and anchorages, approaches and other features of the structure.

A. FRASER ROSE, M. ASCE
Rose & Rose, Structural Engineers
New York, N.Y.

SOCIETY NEWS

There is still time to make plans for attending the Annual Convention in New York, N.Y., October 22–26. Full details of the week-long program were given in the September issue.

ASCE Elects Eight New Officers for 1952

In the second ASCE election since adoption of the new Constitution, the Society has elected a President, two Vice-Presidents, and five Directors. The results of the balloting are given in the Tellers' Report on page 59. The new officers will be inducted at the Wednesday morning meeting during the Society's forthcoming Annual Convention, which will be held in New York, October 22–26.

A biographical sketch of Carlton S. Proctor, newly elected President of the Society and member of the New York City consulting firm of Moran, Proctor, Freeman & Mueser, appeared in the April issue, following his nomination for the presidency. Biographical sketches of the other officers are given here.

George W. Burpee

A specialist in all phases of transportation, George W. Burpee, ASCE Vice-President for Zone I, has been a partner in the New York City consulting firm of Coverdale & Colpitts since 1921. He is a 1904 graduate of Bowdoin College, which gave him the honorary doctor of science degree in 1939, and received the B.S. degree from Massachusetts Institute of Technology in 1906. Prior to his association with Coverdale & Colpitts, he was managing engineer for Dwight P. Robinson & Co., engineers and constructors of New York, and its predecessor company, Westinghouse, Church, Kerr & Co.

As part of his service with Coverdale & Colpitts, Mr. Burpee has been consulting engineer to the Manhattan Railway Co. and the Gulf States Steel Co., Birmingham, Ala; executive vice-president of the American Export Airlines, December 1942 to June 1943; and president of the General Aniline & Film Corporation (an enemy-owned corporation operated under direction of the Alien Property Custodian) from 1943 to 1947. He also was in charge of construction of the Basic Magnesium Plant at Las Vegas, Nev., during 1942.

Joining ASCE as a Junior in 1907, Mr. Burpee became Associate Member in 1911 and Member in 1917. He was Director from 1942 to 1944, and since 1947 has been chairman of the ASCE Budget Committee. He is also a member of the Society's Securities Committee, of which he was chairman for several years; Assistant Treasurer of ASCE; and ASCE representative on United Engineering Trustees. Active in the Metropolitan Section, he has served it as president. He has also been president of the American Institute of Consulting Engineers. At present he is on the Engineering Board of the Port of New York Authority.

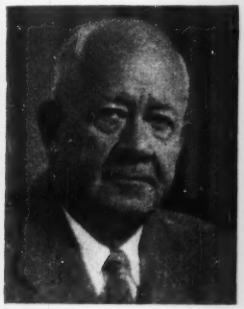
A M Rawn

An authority in the sanitary engineering field, A M Rawn, new Vice-President for Zone IV, has been chief engineer and general manager of the Los Angeles County Sanitation Districts, since 1941. From 1924 to 1941 he was assistant chief engineer for the Districts. An engineer with the U. S. Reclamation Service (now the Bureau of Reclamation) from 1912 to 1924 except for a period of service with the AEF in World War I, Mr. Rawn served on the Yakima, Boise, Salt River, King Hill, and Columbia Basin projects.

During the recent war he was consulting engineer to the Construction Quartermaster of the Army on sewerage and refuse disposal for the major cantonments, and ex-officio director of the sewage and sanitation branch of the governmental division of the War Production Board. He is currently a member of the California State Water Pollution Control Board and the Federal Water Pollution Advisory Board.

Elected an Associate Member of the Society in 1922 and Member in 1924, Mr. Rawn was Director from 1942 to 1944. His service on Technical Division

GEORGE W. BURPEE
Vice-President, Zone I



A M RAWN
Vice-President, Zone IV

WALTER D. BINGER
Director, District 1

FRANK A. MARSTON
Director, District 2

committees included chairmanship of the Joint Sanitary and Irrigation Division Committee on Salvage of Sewage. He was president of the Los Angeles Section in 1938. In 1940 Mr. Rawn was president of the Los Angeles Engineering Council of Founder Societies, and in 1944 of the National Federation of Sewage Works Associations.

GEORGE W. McALPIN
Director, District 6

JAMES A. HIGGS
Director, District 10

ISAAC CLEVELAND STEELE
Director, District 11

Walter D. Binger

Walter D. Binger, Society Director for District 1, has a consulting practice in New York City. He is a graduate of Massachusetts Institute of Technology, with the degree of S. B. in civil engineering, and served as second lieutenant in the Construction Division of the Air Service, A.E.F., 1918.

Mr Binger's career has been divided into three equal time periods, covering (1) Consulting engineering and construction management; (2) charge of design and construction of large buildings in Manhattan for financial groups; and (3) commissioner in the La Guardia administration. In the latter capacity Mr. Binger organized and headed the engineering group, which designed and built the Coney Island and Ward's Island Sewage Treatment Works, sewage tunnels under the East River, and power-producing incinerators. He also organized and headed the group that designed and built the East River Drive; planned the Harlem River Drive, the Battery Underpass, etc. He has been chairman of the Citizens Traffic Action Committee credited with the law that took traffic control from the police and created a Traffic Department under a traffic engineer.

Active in zoning in New York through the Regional Plan Association, Mr. Binger has been director of the organization and member of its Executive and Traffic Committees. He also served three years as member of the Visiting Committee of the Department of Civil and Sanitary Engineering at M.I.T. He represented ASCE on the National Technological Engineering Committee, consisting of one member of each of the national engineering societies, and was appointed chairman by Secretary of War Stimson. In 1948 he was appointed by Secretary of Defense Forrestal as consultant to the Office of Civil Defense Planning on preparation of the Hopley Report.

In 1941 Mr. Binger was sent to London as expert consultant to the Secretary of War to write a confidential report on engineering features of civil defense. He is author of *What Engineers Do*, also, of many articles and co-author of *What the Citizen Should Know About Civil Defense* and *Elements of Sanitation*. He is a member of the American Institute of Consulting Engineers and the Institution of Civil Engineers of Great Britain.

Frank Alwyn Marston

Partner in the engineering firm of Metcalf & Eddy of Boston for the past 31 years Frank A. Marston, Director for District 2, has been engaged on projects involving sewerage works, water works, refuse disposal plants, and drainage problems. Since 1937 he has been consulting sanitary engineer on the staff of the Chief Engineer of the Board of Water Supply of the City of New York. Major projects with which he has been connected include a sewage treatment plant and sewers for the District of Columbia, sewerage works for Louisville, Ky., reconstruction of pumping stations and a new mechanical water filter plant for Wilmington, Del., and many other projects in the sanitary engineering field. He is a graduate of Worcester Polytechnic Institute.

Mr. Marston became a member of the Society as a Junior in 1910, Associate Member in 1917, and Member in 1920. He has been a member of the Committee on Engineers' Code; member of the Society's Committee on Professional Fees, of which he was chairman for one year; and member of the executive committee of the Soil Mechanics and Foundations Division, and chairman for four years. At present he is chairman of the Division Committee on Collaboration with Foreign Engineering Societies.

A life member of the Boston Society of Civil Engineers, Mr. Marston has served it as president. He is also a life member of the New England Water Works Association, and member of other technical societies.

George W. McAlpin

George W. McAlpin, Director for District 6, received his engineering education at the University of Cincinnati. After service for several years with the U. S. Engineer Office at Cincinnati, Ohio, on Ohio River lock and dam surveys, design and construction, Mr. McAlpin became associated with the National Contract Company, of Evansville, Indiana, in 1918, as superintendent and engineer on Ohio River lock and dam and other heavy construction projects. In 1922, he formed a partnership, Skene and McAlpin, to engage in engineering design and the construction of roads, structures, public and industrial buildings and schools, in the states of West Virginia, Ohio and Kentucky.

Entering the service of the West Virginia State Road Commission, in 1933, Mr. McAlpin was appointed district engineer with headquarters at Charleston, W.Va. He was named state planning engineer in 1936 and organized the present planning division. Since 1941 he has been state construction engineer in charge of design and construction of all state contract construction of roads and bridges.

Mr. McAlpin is a registered professional engineer in West Virginia. Becoming a Member of ASCE in 1937 he has served as president of the West Virginia Section and, for many years, chairman of the Local Qualification Committee. He is also a member of the West Virginia Society of Professional Engineers, a past-president of the Charleston Chapter,

and a state director of the organization. He is a member of and has been active in committee work of the American Association of State Highway Officials, the Southeastern Association of Highway Officials, the American Road Builders' Association and the Highway Research Board.

James A. Higgs

James A. Higgs, ASCE Director for District 10, has spent most of his career with the Massey Concrete Products Co. A graduate of North Carolina State College in 1906, with the degree of bachelor of engineering, he received the C.E. degree there in 1910. After several years in the Construction Department of the Southern Railway, he started his own business, specializing in reinforced concrete structures.

In March 1917 Mr. Higgs opened an office for the Massey Concrete Products Co., at Norfolk, Va., and in August of that year entered the Army for service in World War I. He served as balloon observer and later as company commander in France and took part in the St. Mihiel and Meuse-Argonne battles. He was awarded the D.S.C. in November 1918. On return to civilian life, Mr. Higgs opened the Atlanta office of the Massey Concrete Products Co., as resident manager serving the Southeastern states. In December 1950 he became a vice-president of the company.

Joining ASCE as Associate Member in 1919, Mr. Higgs became a Member in 1948. He has served on the ASCE Local Sections Committee and various committees of the Georgia Section. He has also been secretary-treasurer and president of the Georgia Section. His other affiliations include the American Railway Engineering Association, the Georgia Engineering Society, the National Society of Professional Engineers, and the Society of American Military Engineers.

Isaac Cleveland Steele

A specialist in the public utility field, I. C. Steele, new Director from District 11, has been with the Pacific Gas and Electric Company since his graduation in 1909 from the University of California at Berkeley. After early work for the organization on the Lake Arthur and Lake Valley dams, he was office assistant in the general office (1910 to 1914); assistant engineer and superintendent of building construction (1914 to 1917), and civil engineer in the general office in San Francisco (1917 to 1921).

As chief of the company's Division of Civil Engineering from 1921 to 1944, Mr. Steele was in charge of surveys for hydroelectric plants; designs for structural and hydroelectric projects, irrigation systems, and special structures; and water, power, and load studies. He became chief engineer in 1944, and has been vice-president and chief engineer in San Francisco since July 1, 1947.

Mr. Steele's professional work includes initiation of the planning, development, and programming of additions and changes to his company's hydro and steam-electric plant properties and the design of all physical facilities except those employed in the transportation and distribution of gas. He has also been instrumental in the organization and maintenance of an engineering personnel known throughout the state for its resourcefulness and ability. He is author of various articles in technical journals and of a chapter on "Rock-Fill Dams" in the McGraw-Hill *Handbook of Applied Hydraulics*, edited by Calvin V. Davis.

A member of ASCE since 1923, Mr. Steele is a member and past-president of the San Francisco Section. He has also been president of the Engineers' Club of San Francisco.

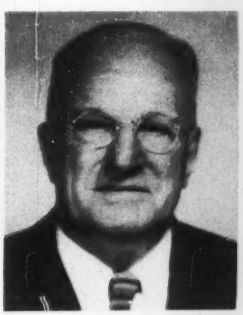
Careers of Four New Honorary Members Are Summarized

Samuel A. Greeley

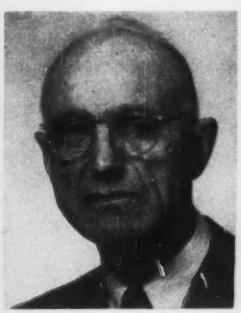
A nationally known authority in the sanitary engineering field, Samuel A. Greeley is senior partner in the Chicago engineering firm of Greeley & Hansen. Their practice includes all aspects of water, sewage, industrial waste, and refuse works. A few of the firm's recent projects have been for the widely separated cities of Los Angeles, Washington, Philadelphia, Tampa, Winnipeg, and for the Canal Zone.

A graduate of Harvard College in 1903, with the A.B. degree, and of Massachusetts Institute of Technology in 1906, with the S.B. degree in sanitary engineering, Mr. Greeley's first employment was with the sanitary engineering firm of Hering & Fuller in New York City, for whom in 1908 he was resident engineer on the construction of a large refuse incineration plant for Milwaukee. Later he was in charge, for James H. Fuertes, of investigations for water supply and sewage disposal at Caracas, Venezuela, and in 1912 became an assistant engineer in the Sanitary District of Chicago. In

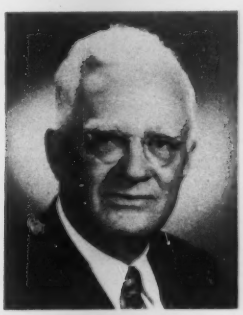
Samuel A. Greeley, Hon. M.



Charles Gilman Hyde, Hon. M.



Jonathan Jones, Hon. M.



Frederick Ohrt, Hon. M.

1914 he went into partnership with Langdon Pearse under the firm name of Pearse & Greeley. In 1920 the firm name became Pearse, Greeley & Hansen, and since 1932 it has been Greeley & Hansen.

Long a member of ASCE, Mr. Greeley was president of the Illinois Section in 1934 and 1935 and has served on a dozen Society committees and been chairman of six. Since 1949 he has been chairman of the Joint Committee on Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works and six other national organizations.

For his papers in the TRANSACTIONS of the Society, Mr. Greeley has been awarded the Thomas Fitch Rowland Prize, the Rudolph Hering Medal, and the James Laurie Prize. His most recent award was the Frank P. Brown Medal of the Franklin Institute, which carries a citation for "leadership in the profession of sanitary engineering and many contributions to knowledge in that field which have particularly improved the welfare of urban populations."

Charles Gilman Hyde

Combining engineering teaching and consulting work in a long career of public service, Charles Gilman Hyde was an instructor in civil, hydraulic, and sanitary engineering subjects at the University of California for 39 years. Since his retirement in 1944, with the rank of professor of sanitary engineering, emeritus, he has continued his sanitary and hydraulic engineering practice in Berkeley.

Born at Norwich, Conn., he was educated at Norwich Academy and at Massachusetts Institute of Technology, from which he received the B.S. degree in sanitary engineering in 1896. Prior to going to California in 1905, he served four years in the engineering department of the Massachusetts State Board of Health; two years in Philadelphia on water purification investigations; and three years in Harrisburg, Pa., on water purification experiments and the design and construction of water treatment works.

During his 46 years in California, Professor Hyde has been actively concerned with a number of water supply, sewerage, and environmental control problems and projects in the Pacific Coast area. He is author and co-author of numerous professional reports and papers that have been published in the technical press or separately.

Affiliated with many professional organizations, he is a national honorary member of the American Water Works Association, the Federation of Sewage Works Associations, and Chi Epsilon. In 1949 he was awarded the honorary degree of doctor of laws by the University of California. Long active in ASCE and the San Francisco Section, Professor Hyde was president of the Section in 1938.

Jonathan Jones

As chief engineer of fabricated steel construction for the Bethlehem Steel Co. and as contributor to numerous research groups, Jonathan Jones has made practical application of research advances in the structural field to the fabrication and erection of some of the country's most notable bridges and buildings.

A graduate of the University of Pennsylvania in 1903 with the A.B. degree, Mr. Jones subsequently did graduate work there for which he received advanced science and civil engineering degrees. Except for two years with the Pennsylvania Railroad at the outset of his career and seven years (1913 to 1920) with the City of Philadelphia as engineer of bridges, Mr. Jones has spent his career with the Bethlehem Steel Co. and its predecessor organization, the McClintic-Marshall Co.

From 1920 to 1923 he was resident engineer for McClintic-Marshall at Jamshedpur, India, in charge of erection of steel mill buildings for the Tata Iron & Steel Co. and the Tinplate Co. of India. From 1923 to 1929 he was assistant chief engineer in charge of major bridge contracts; including negotiations, design and construction of the Ambassador Bridge at Detroit. He then served as chief engineer of the company until the time of its purchase by the Bethlehem Steel Co. in 1931. During his tenure with the Bethlehem Steel Co., Mr. Jones has been in charge of the fabrication and erection of the Golden Gate Bridge and many other notable structures.

A member of ASCE since 1910, Mr. Jones has served as president of the Lehigh Valley Section. His contributions to the Society's technical work include chairmanship of the executive committee of the Structural Division. He has also been active in numerous other professional and research groups and is author of several technical publications.

Frederick Ohrt

Water development and conservation on Pacific Islands, with special emphasis on the water resources of Hawaii, have been the chief concern of Frederick Ohrt during the past quarter of a century. His continuing efforts to prevent depletion of the main ground-water reserves and his interest in municipal and government activities have given him an outstanding place in Territorial development.

Born on the Island of Maui when the Hawaiian Islands were still a kingdom, he obtained his higher education on the mainland, receiving his C.E. degree at Cornell University in 1911 after first attending the University of Oregon. Later he completed graduate work at the Harvard-M.I.T. school for health officers.

His long career in Hawaii has included positions as resident engineer on the three-mile Waiahole water tunnel project; sanitary engineer for the Territorial Board of Health; chief engineer for the City and County of Honolulu; consulting engineer for the pineapple division of the Libby, McNeill & Libby branch in Hawaii on construction of harbor and pier facilities; and chief engineer for the Honolulu Sewer and Water Commission on modernization of the sewer and water systems.

As manager and chief engineer of the Board of Water Supply of the City and County of Honolulu since 1929, Mr. Ohrt initiated broad-scale research work and has been responsible for extensive ground-water development construction. He has also contributed to knowledge of salt water intrusion on Pacific Islands, and has written several papers on the subject and on the Honolulu water works. During World War II he was a consultant for the Navy on the development of water supplies on the Pacific Islands of Guam, Saipan, Tinian, and Iwo.

Active in promoting better government for the Territory, he has been largely responsible for the present laws on civil service, classification, and the retirement-pension plan for government employees. A member of ASCE since 1918, he was active in forming the Hawaii Section of the Society in 1938. His other affiliations include the Engineering Association of Hawaii, of which he is past-president.

Scheduled ASCE Conventions

ANNUAL CONVENTION
New York, N.Y., October 22–26

NEW ORLEANS CONVENTION
New Orleans, La., March 5–7, 1952

DENVER CONVENTION
Denver, Colo., June 16–20, 1952

CENTENNIAL OF ENGINEERING
Chicago, Ill., September 3–13, 1952

ASCE Prizes to Be Awarded at New York Meeting

Presentation of ASCE prizes and medals for papers in Volume 115 of TRANSACTIONS (1950) will be made at the Wednesday morning session of the New York Meeting on October 24. The Construction Engineering Prize differs from the others in being specifically limited to material appearing in CIVIL ENGINEERING. Descriptions of the various awards are given on page 96 of the Official Register for 1951.

Highlights in the careers of those receiving prizes and medals follow.

D. B. Steinman

D. B. Steinman, M. ASCE, winner of the Norman Medal, for his paper on "Aerodynamic Theory of Bridge Oscillations" is an internationally known bridge engineer and authority on the design of suspension bridges. Born and educated in New York City, he holds five degrees and numerous medals and honors from City College and Columbia University. He started his career with Gustav Lindenthal on the design and construction of the Hell Gate Arch Bridge and the Sciotoville Bridge. At an early age he was professor of civil engineering at the University of Idaho and then professor of civil and mechanical engineering at the College of the City of New York.

He started his own firm in 1920. His bridge engineering engagements have extended to five continents and have included six bridges honored in the annual AISC bridge awards for the most beautiful bridges.

Dr. Steinman is honorary member, life member, fellow, and past-president of many engineering and scientific societies in this country and abroad. He is past-president of the Metropolitan Section, ASCE, past-chairman of the Structural Division, ASCE, and present chairman of the U.S. Council of the International Association of Bridge and Structural Engineers. Author of numerous books, papers and technical articles, he has contributed seven papers to ASCE TRANSACTIONS and has received four medals and prizes for these papers.

M. E. Von Seggern

Well known in the field of water development and conservation is M. E. Von Seggern, Assoc. M. ASCE, winner of the J. James R. Croes Medal for his paper on "Integrating the Equation of Nonuniform Flow."

Mr. Von Seggern has been with the Bureau of Reclamation since 1946 and is at present assistant district engineer of the Missouri-Oahe District Office at Huron, S. Dak., where a $350,000,000 water-resource-development program is being planned and constructed as a part of the Missouri River Basin Project. From 1942 to 1946 he was engaged in the planning of multiple-purpose river developments in the Mobile District of the Corps of Engineers. Prior to that he was connected with the Forest Service at Denver, the Central Nebraska Public Power and Irrigation District at Hastings, and the Omaha District of the Corps of Engineers. He graduated from the University of Nebraska in 1933.

William K. Boyd and C. R. Foster

The Thomas Fitch Rowland Prize goes to William K. Boyd, M. ASCE, and C. R. Foster, Assoc. M. ASCE, for their paper entitled "Design Curves for Very Heavy Multiple Wheel Assemblies."

Mr. Boyd went directly to the North

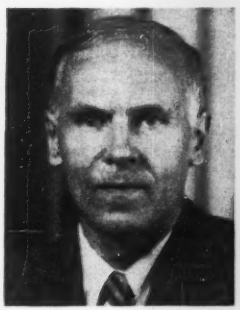
D. B. STEINMAN
Norman Medal

M. E. VON SEGGERN
J. James R. Croes Medal

WILLIAM K. BOYD

C. R. FOSTER
Thomas Fitch Rowland Prize

HANS H. BLEICH
James Laurie Prize



A. HRENNIKOFF
Arthur M. Wellington Prize

JOHN W. FORSTER

RAYMOND A. SKRINDE
Collingwood Prize for Juniors

M. L. ALBERTSON

Y. B. DAI

R. A. JENSEN

HUNTER ROUSE

Karl Emil Hilgard Prize

Dakota State Highway Department upon graduation from the University of North Dakota in 1926. He became a division engineer in 1935 and subsequently was appointed materials engineer. In the latter position he was instrumental in developing the North Dakota Cone, an instrument used to judge the stability of a subgrade soil, and based on its use proposed a method of determining pavement-thickness requirements for highway traffic. He joined the Corps of Engineers in 1943 as chief of the newly created Flexible Pavement Branch, Soils Division, Waterways Experiment Station at Vicksburg. There he actively directed the program of research, including the design and construction of several test sections, the traffic tests conducted thereon, and the subsequent data analysis which led to the formulation of flexible pavement design criteria for very heavy wheel loads adopted by the Corps. Mr. Boyd left the Corps of Engineers in 1950 to join the Bureau of Public Roads as materials engineer for Division 10 of that organization in Juneau, Alaska.

Mr. Foster has been with the Corps of Engineers working in the fields of soil mechanics and pavements since 1936. He started in the soils laboratory in the Memphis District, and transferred to the Little Rock District in 1937. Until 1942 his work was in connection with the design of dams and levees except for a year on field construction at Blue Mountain Dam in Arkansas. In the spring of 1942 when the Corps of Engineers became active in airfield pavement construction, Mr. Foster was engaged on the design of airfield pavements in the Little Rock District. In 1943 he was assigned to the Barksdale Field, Louisiana test section, a major research project in the design of flexible pavements. In 1944 he was transferred to the Waterways Experiment Station, where he has been actively engaged in research work on flexible pavements. He is now chief of the Flexible Pavement Branch, Soils Division. He served as Corps of Engineers' specialist in Germany during the enlargement of the Berlin airfields at the time of the Airlift operation. Mr. Foster attended Jones County (Mississippi) Junior College and has furthered his education by extension work at Mississippi State College and a summer course in soil mechanics at Massachusetts Institute of Technology.

Hans H. Bleich

Teacher and research specialist, Hans H. Bleich, M. ASCE, winner of the James Laurie Prize for his paper on "Frequency Analysis of Beam and Girder Floors," is a native of Vienna, and was educated at the Austrian Technical University. Before coming to the United States in 1945 he was engaged in the design of bridges and industrial plants in Austria and in Great Britain. The prize-winning paper was conceived as a result of experiences in the design of power plants in England.

In 1945 Mr. Bleich joined the New York consulting firm of Hardesty & Hanover as designer, and later associate engineer. Lecturer at Columbia University since 1946, Mr. Bleich is now associate professor of civil engineering. He is the author of a booklet on the design of suspension bridges and of a number of research papers.

Alexander Hrennikoff

Winner of the Arthur M. Wellington Prize is Alexander Hrennikoff, M. ASCE, for his authorship of a paper on "Analysis of Pile Foundations with Batter Piles." A native of Moscow, Mr. Hrennikoff was graduated from the Institute of Ways of Communication there in 1920. In 1925, after railroad and construction experience in Russia and Manchuria, he went to Vancouver, B.C., to make his home. There he attended the University of British Columbia, receiving the degrees of B.A.Sc. and M.A.Sc. in civil engineering.

Between 1929 and 1933 Mr. Hrennikoff worked as detailer and designer of steel frames and bridges for the Dominion Bridge Co. In 1933 he was appointed an instructor in civil engineering at the University of British Columbia, where he gradually rose in rank to his present position of professor of civil engineering. Between 1938 and 1940, while on leave of absence, he attended the Massachusetts Institute of Technology, receiving the doctor of science degree in structural engineering. He has taken a prominent part in the university's postwar expansion program, planning its new engineering building and designing equipment for the materials testing and hydraulics laboratories.

Dr. Hrennikoff has devoted much of his time to theoretical research in the fields of applied mechanics and structural engineering, and the results of his investigations have been presented in a number of papers in engineering journals here and in Europe. In 1950 he was the winner of the Leon S. Moisseiff Award of ASCE.

John W. Forster and Raymond A. Skrinde

This year the Collingwood Prize for Juniors is awarded jointly to John W. Forster and Raymond A. Skrinde, Junior Members ASCE, for their paper on "Control of the Hydraulic Jump by Sills."

A graduate of the University of Alberta (Canada) in 1944, with the degree of B.Sc. in civil engineering, Mr. Forster later did graduate work at the State University of Alberta, receiving the degree of M.Sc. in hydraulic engineering from the State University of Iowa in 1947. From 1944 to 1946 he was engineer for the Alberta Department of Water Resources. Later he was lecturer in hydraulic engineering subjects at the University of Alberta; hydraulic engineer for the City of Edmonton, Alta.; and acting provincial sanitary engineer for Alberta. From 1948 to 1951 he was hydraulic engineer for the Hydroelectric Construction Department, Companhia Brasileira Administradora Servicos Tecnicos, Sao

Paulo, Brazil, and he is now with Canadian-Brazilian Services Ltd., in Toronto, Canada.

Mr. Skrinde received his bachelor degree in civil engineering from the State College of Washington and his master's degree from the University of Iowa, where he specialized in hydraulics. From 1941 to 1945 he was a commissioned officer in the Army Engineer Corps. In 1947 he was a hydraulic engineer with the Bureau of Reclamation hydraulic laboratory at Denver, Colo., and in 1948 a hydraulic engineer with the General Electric Company at Richland, Wash. Since the latter year, he has been a hydraulic engineer with the Corps of Engineers at Walla Walla, Wash.

James S. Holdhusen

The J. C. Stevens Award goes to James S. Holdhusen, Jun. M. ASCE, for his discussion of the paper, "Diffusion of Submerged Jets." Mr. Holdhusen did both his undergraduate and graduate work at the University of Minnesota. For the past four years he has been engaged in research and instruction in fluid mechanics at the same institution.

M. L. Albertson, Y. B. Dai, R. A. Jensen, and Hunter Rouse

This year the Karl Emil Hilgard Prize, a biennial award, goes jointly to M. L. Albertson, Jun. M. ASCE, Y. B. Dai, R. A. Jensen, and Hunter Rouse, M. ASCE, for their paper on "Diffusion of Submerged Jets."

With a background of research and teaching in the hydraulic engineering field, Maurice L. Albertson is now professor of civil engineering and head of fluid mechanics research at Colorado Agricultural & Mechanical College. His work there includes teaching hydraulic courses related to irrigation engineering and directing research on evaporation and diffusion, sand traps, sediment transportation and deposition, and design of spillway crests and stilling basins. Before joining the Colorado A & M faculty in 1947, he conducted research at the Iowa Institute of Hydraulic Research and taught courses in mechanics and hydraulics at the State University of Iowa. He received his B.S. in civil engineering at Iowa State College in 1941, and has the graduate degrees of M.S. and Ph.D. in hydraulic engineering from the State University of Iowa. Author of many papers on hydraulic engineering subjects, he received the Society's J. C. Stevens Award in 1948 and is chairman of the Society's Joint Committee on Ground Water.

A native of China, Mr. Dai received the B.S. degree from the National Tungchi University of China, where he worked for several years as assistant and instructor. In 1944 he passed the government examinations required of all engineers wishing to study abroad, and in February 1945 enrolled in the Graduate College of the State University of Iowa. He completed requirements for the M.S. degree in mechanics and hydraulics in February 1947, and thereafter was employed as research assistant by the Iowa Institute of Hydraulic Research. He returned to China in October 1947. Latest word indicates that he is associate professor in the Engineering College of the National Hunan University at Changsha.

Mr. Jensen graduated from the University of Minnesota in 1940 with a B.Ch.E. degree. Following two years as chemical engineer in the Research Department of Cliffs-Dow Chemical Co., Marquette, Mich., he was appointed project engineer at the Engineering Experiment Station, Pennsylvania State College. From July 1943 until July 1946 he was research associate at the Institute of Hydraulic Research, State University of Iowa, receiving the degree of M.S. in Ch.E. in June 1946. He then became project engineer at the U.S. Government Synthetic Rubber Laboratories operated by the University of Akron at Akron, Ohio. Later he was on the staff of Battelle Memorial Institute, Columbus, Ohio, as research engineer and principal chemical engineer, respectively, and since April of this year he has been employed as process chemical engineer at the Houston, Tex., plant of the Rohm and Haas Co.

An authority in the field of fluid mechanics and allied hydraulic subjects, Hunter Rouse is professor of hydraulics at the State University of Iowa and director of the Iowa Institute of Hydraulic Research there. A 1929 graduate of Massachusetts Institute of Technology with the degree of S.B., he was M.I.T. Traveling Fellow in Europe from 1929 to 1931 studying laboratory technique. Returning to M.I.T. as assistant in hydraulics, he received the degree of S.M. in 1932, and that summer passed an examination in Karlsruhe, Germany, for the degree of doktoringenieur. He taught at Columbia University and California Institute of Technology before going to the University of Iowa in 1939 as professor of fluid mechanics. He has been director of the Institute of Hydraulic Research since 1944. Author of many papers on hydraulic research subjects, Dr. Rouse received the Society's Norman Medal in 1938 and the ASEE's George Westinghouse Award in 1948.

Francis R. Shanley

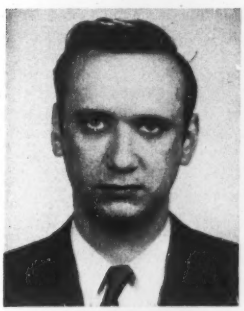
Francis R. Shanley, winner of the Leon S. Moisseiff Award for his paper on "Applied Column Theory," is professor of engineering at the University of California. A graduate of Pennsylvania State College, class of 1927, he had early experience with the newly-formed Consolidated Aircraft Corporation in Buffalo, N.Y., and with the Civil Aeronautics Administration in Washington, D.C. His work there was concerned with structural analysis of airplanes, and he later headed a group that developed airworthiness requirements for U.S. airplanes.

By 1937 the Consolidated Aircraft Company had moved to San Diego, and Mr. Shanley accepted the position of structures research engineer. Later he was head of the Lockheed Aircraft Engineering Research Laboratory, did consulting work for the Rank Corporation, and was lecturer at the University of California (Los Angeles). In 1949 he joined the faculty as a professor. He is the author of a textbook, *Basic Structures*, and has written many technical papers on structures.

James G. Tripp

For his paper in the March 1951 issue of CIVIL ENGINEERING, entitled "Will a Construction Cableway Fit Your Job?" James G. Tripp, M. ASCE, receives the Construction Engineering Prize—the only award specifically intended for material appearing in CIVIL ENGINEERING.

As president of the Tripp Construction Corp., New York City, Mr. Tripp provides a consulting service to contractors. His clients have included the joint venturers on Shasta and other notable dam projects. He has been project manager on such innovations as the largest multiple-arch dam in the country, the smallest constant-angle arch dam; the only



JAMES S. HOLDHUSEN
J. C. Stevens Award

JAMES G. TRIPP
Construction Engineering Prize

multiple-dome dam (Coolidge Dam at San Carlos, Ariz.); and the first isostic-balance cofferdam on the Mississippi. He is the originator of many construction tools and methods for difficult concrete work. Mr. Tripp was educated at Massachusetts Institute of Technology, class of 1910.

EJC Recommends Correction of Salary Inequities

At the request of the U.S. Salary Stabilization Board, Engineers Joint Council has submitted its recommendations for correcting current salary inequities in the engineering profession created by the shortage of engineers. At its meeting on September 14 EJC approved the report of its Special Panel on Salary Stabilization, of which ASCE President Gail A. Hathaway was chairman, and transmitted the following statement to the Salary Stabilization Board over the signature of James M. Todd, president of EJC.

1. The increase in the industrial and technical load to prepare the nation's economy for defense has resulted in an unusual and sudden demand for engineers which has created many inequities and imbalances in engineering salaries.

2. Engineers are in short supply. The situation will get worse, and there is no immediate solution in sight. Immediate alleviation can come only by more rapid advancement of those who show capacity for broadening their activities and assuming additional responsibilities. Adequate salary treatment in such cases is imperative.

3. The normal process of development of the engineer from graduation includes a period of training in industry and progressive growth to increased responsibility in all phases of engineering practice.

4. One of the inherent difficulties in comparing the values of engineering services is the difficulty in describing or classifying the skills that are used. As the engineer advances in experience, he is able to grasp engineering problems and evolve engineering designs more quickly, the volume of work he produces increases, and yet he may continue to hold the same job designation he had when he started his work.

5. Not only does an engineer become more productive as he gains experience, but actually the contributions of each individual vary widely depending on his creative ability, training, and other personal characteristics. Therefore, in the absence of a plan which provides for promotion of an engineer from one arbitrary job classification to another, each merit increase may be, at least partly, a promotion increase and must be made on the basis of an appraisal of the individual's growth and contribution to the business.

6. More recent graduates are needed than are available. This shortage has led to the payment of increased starting salaries by many employers at rates that are materially above the rates the same employer was paying before 1950. Experienced engineers also are in short supply and many are underpaid.

7. The justifiable increases in starting rates for engineers that have been made effective since 1949 have in many cases flattened the previous experience-salary curves. This is because employers have not always made increases in the compensation of experienced engineers in proportion to increased starting rates. This has resulted in serious inequities as between salaries of older engineers and salaries of those just starting their careers.

8. Differentials which normally exist between engineering (and executive) salaries and those of non-exempt employees with whom they are associated (draftsmen, clerks, mechanics, etc.) are either materially reduced or disappear altogether when, in a period like the present, industry finds it necessary to operate on schedules in excess of forty hours per week. This is particularly true of the younger or lower-paid professional employees and executive employees. Overtime payment practices for exempt employees vary widely between companies. The salary stabilization regulations should be amended to permit the payment of premiums for scheduled overtime to exempt employees not to exceed the treatment given non-exempt employees in the same organization.

9. Certain segments of the engineering profession were at abnormally low salary levels at the time of the salary freeze. A serious loss of technical personnel in these elements of the economy is being created because of their depressed salary rates. Methods must be provided to permit the equalizing of salary rates to obtain a balanced distribution of professional personnel in all phases of engineering service in the national economy.

10. To minimize the tendency of engineers to shift from one organization to another due to the factors enumerated above, with resulting loss of productivity, it is believed that pre-qualification should be required of contractors, whether for engineering services, construction or supply. In addition, as recommended more specifically below, opportunity should be afforded to employers to compensate their engineers fairly and adequately, thereby permitting those organizations that are essential to national health, welfare, and defense of the country to maintain their professional staffs.

11. All these considerations lead to the following recommendations of Engineers Joint Council, representing a membership of 130,000 engineers, that the regulations of the Salary Stabilization Board should permit:

(*a*) Correction of salary inequities created by the current high level of starting salaries of young engineers so as to permit commensurate increases of salaries for older, qualified, and well-experienced engineers.

(*b*) Correction of salary inequities in areas where engineering salaries were abnormally low at the time of the wage and salary freeze.

(*c*) Clarification of Section 8 (6) *e* of Circular GSSR No. 1 to indicate flexibility of treatment of so-called "rare and unusual cases" as concerning engineers because of the existing serious manpower shortage of engineers.

(*d*) Appropriate salary increases for professional employees and others in cases where responsibilities vary with the competencies of individuals, and where the job classifications are impracticable.

(*e*) Premiums for scheduled overtime to exempt employees not to exceed the treatment given non-exempt employees in the same organization.

ASCE Yearbook for 1952 Must Be Requested

As in the past, the new Yearbook membership list, which is being processed for publication in January 1952, will be available without charge to all Society members. However, in the interests of economy, the new two-year edition will be mailed only to members specifically requesting it. The size of the edition will be determined by the number of requests received. To facilitate ordering, a coupon has been provided on page 79. Copies will be distributed automatically to officers of the Society and to Local Sections.

The proposed method of mailing, which is in line with the practice of other professional societies, is necessitated by increased production and mailing costs.

Professional Problems Studied at EJC Meeting

Several problems of critical concern to the profession were discussed at the September 14 meeting of Engineers Joint Council, held in New York City. In addition to the study of salary inequities reported elsewhere in this issue, the agenda included the following actions:

National Science Foundation

Action was taken to have vacancies on the National Science Foundation Board filled by qualified engineers, and to have capable engineering scientists named to its permanent staff. Taking cognizance of the need for basic research in the United States and the complete inadequacy of the $300,000 appropriation approved by the House of Representatives to make any progress in this direction, EJC acted to recommend that an adequate amount be appropriated.

Engineering Manpower Convocation

Under sponsorship of the EJC Manpower Commission, a large convocation is scheduled for September 28 in Pittsburgh for the purpose of explaining the shortage of engineers and for developing methods of guiding talented high school students into the profession. The attendance will include personnel and management authorities from industry, Parent Teacher Association groups, and delegates from all over the United States.

National Water Policy

A critique by the EJC Panel of the Report of the President's Committee on National Water Resources is expected to be in print in October ready for distribution to members of Congress and other interested persons.

Engineering Fees for Governmental Construction

Differing policies of governmental agencies for determining fees for engineering construction have been a concern of EJC. Council's recommendations are now before the Munitions Board for resolution. EJC Societies have asked for a hearing by the Munitions Board before action is taken.

Centennial of Engineering, 1952

Plans for the Exposition and Convocation in Chicago during 1952 to mark the centennial celebration of ASCE were reported to be progressing satisfactorily. The program of the Convocation during the week September 3–13 contemplates presentations covering a wide variety of engineering and industrial accomplishments. ASCE and the other EJC Societies are supporting a program to provide opportunity for participation by engineers in all branches of the profession.

Tellers Canvass Ballot for 1952 ASCE Officers

September 12, 1951

To the 1951 Annual Meeting American Society of Civil Engineers:

The Tellers appointed to count the Election Ballots for Officers of the Society for 1952 report as follows:

For President
(Term October 1951–October 1952)

Carlton Springer Proctor	9,125
Scattering	12
Void	3

For Vice-President—Zone I
(Term January 1952–October 1953)

George William Burpee	1,872
Scattering	13
Void	0

For Vice-President—Zone IV
(Term January 1952–October 1953)

A M Rawn	2,862
Scattering	15
Void	1

For Director—District 1
(Term January 1952–October 1954)

Walter David Binger	1,082
Scattering	17
Void	0

For Director—District 2
(Term January 1952–October 1954)

Frank Alwyn Marston	516
Scattering	1
Void	0

For Director—District 6
(Term January 1952–October 1954)

George Washington McAlpin	670
Scattering	1
Void	0

For Director—District 10
(Term January 1952–October 1954)

James Allan Higgs	788
Scattering	2
Void	0

For Director—District 11
(Term January 1952–October 1954)

Isaac Cleveland Steele	1,656
Scattering	6
Void	1

Ballots counted	18,643
Ballot envelopes rejected:	
Without signature	164

Respectfully submitted,
R. Edward Kuhn, *Chairman*
Paul M. Wentworth, *Vice-Chairman*

Burr L. Chase, Jr.	Fred J. Levine
Warren G. Cummings	Arthur R. Luecker
Henry Goldfinger	Charles D. Morrissey
Thomas K. A. Hendrick	Frederick W. Ockert
Edward S. Jarosz	Malcolm Pirnie, Jr.
	Milton C. Shedd

(*Tellers*)

AGC–ASCE Joint Committee Meets in Chicago

Extreme confusion has been produced by federal controls on construction, and unless there are changes to make the regulations workable, many additional hardships will be placed on the construction industry, the Joint Cooperative Committee of ASCE-AGC, concluded at a meeting held in Chicago on September 7. Some federal defense agencies are not aware of the special operating procedures of the industry, it was further decided by the Joint Committee, which met as part of the mid-year board meeting of the AGC reported elsewhere in this issue.

Many States Adopt Termination Clauses

The Joint Cooperative Committee reaffirmed its previous position that termination clauses in construction contracts are of great importance, in view of the uncertainties today as to delivery of critical materials. The five states of California, Utah, Kansas, Iowa and New York have passed special laws making it legal for construction contracts of those states to be terminated, the Joint Committee was informed.

Twelve additional states have inserted termination provisions in their highway construction contracts or special provisions for highway work. These states are Colorado, Illinois, Indiana, Kentucky, Michigan, Minnesota, Missouri, New Hampshire, North Dakota, Ohio, Oklahoma, and Wyoming. Similar action has been taken by the Territory of Hawaii.

Construction Experience Helpful Toward Registration

At past meetings of the Joint Committee the value to be placed on an engineer's experience when working on construction as the contractor of the representative as related to registration as a professional engineer has been discussed. The Joint Committee was in-

formed that since its last meeting there has been major improvement in the matter in California, and it is now believed that engineers working on construction in that state will receive proper credit for such work.

Action of the subcommittee on qualifying experience of the National Council of State Boards of Engineering Examiners at the Council's last convention was reviewed by the Joint Committee, which is pleased by the fact that the subcommittee of the National Council has revised its policy regarding experience on construction so that it now reads:

"It is the sense of the National Council of State Boards of Engineering Examiners that work as a contractor be considered as experience qualifying an applicant for admission to examination for registration when such experience in the opinion of the Board has involved responsible supervision of a character that will tend to expand the engineering knowledge and skill of the applicant; in which event the Board may in its discretion, give such credit therefor as it may deem proper."

ASCE Completes Comprehensive Project

ASCE representatives present reported that a special Task Committee of the Society had recently completed its work of revising the Suggested Form of Contract for Engineering Construction. This work follows a similar project by an AGC task group. The work of ironing out differences between the two drafts will be undertaken immediately and it is expected the final version can be completed at an early date.

The AGC task group that revised the Suggested Contract Form also has completed review of the Standard Questionnaires and Financial Statement for Bidders for Engineering Construction (Form Q.E.C.). Only minor changes have been recommended, and the document will be turned over to the ASCE at once for its study and suggestions.

Engineers' Salaries

After study of the recent U. S. Department of Labor report on the supply of engineers and review of the actions of the Salary Stabilization Board, the Joint Committee concluded that the salaries of most engineers are far below what is deemed reasonable. Because of the unattractive salaries being paid a high percentage of engineers, many members of the profession, particularly younger employees, are joining unions as a method of securing better income.

In concluding discussion of this subject, the Joint Committee passed a resolution urging that both the ASCE and the ACG make every effort to secure increased compensation for engineers and that the present difficulty be forcefully reported to the key people of the Salary Stabilization Board, and that all branches of the engineering profession and the construction industry be asked to add their assistance to the program.

Lester Rogers, president of Bates and Rogers Construction Corp., Chicago, presided at the meeting, which was attended by about 20 representatives of the two organizations.

Centennial Stamp Bill Is Introduced in House

Honorable S. J. Crumpacker, Jr., Indiana, on September 19 introduced bill, H.R. 5402, which when passed, authorizes the Postmaster General to issue a special postage stamp during 1952 commemorating the one-hundredth anniversary of ASCE.

In introducing the bill Congressman Crumpacker said, "One hundred years ago, engineering in America was divided into only two branches—military and civil. Although we now have many specialized branches of engineering and many national societies of engineers, all are a part of the one-time civilian or civil engineering profession. As such, all have a real interest in celebrating the centennial of engineering in 1952.

"During the past century, our country has developed to a position of world leadership very largely through the contributions of engineering and technology. The centennial celebration is viewed as an opportunity to commemorate the services of the engineering profession and to bring to the people of this country and of the world a more complete understanding of the reasons why the United States has become great, and of the contributions of engineering to its development.

"Mr. Speaker, in fairness to the engineering profession and ourselves, I think we should take this opportunity of recognizing the tremendous service to our national progress which it has helped to make possible."

ASCE MEMBERSHIP AS OF SEPTEMBER 7, 1951

Members	7,973
Associate Members	10,230
Junior Members	14,921
Affiliates	68
Honorary Members	38
Fellows	1
Total	33,231
(September 9, 1950	29,835)

Death Takes Two Honorary Members

Charles H. Purcell

Charles Henry Purcell, Honorary Member of the Society and former California State Director of Public Works, died suddenly at his home in Sacramento on September 7, at the age of 68. Mr. Purcell held the office of public works director from January 1943 until July of this year when ill health forced his retirement. Praised by Governor Warren "as a great citizen who gave his life to his State," Mr. Purcell entered California public service in 1928. Earlier he had been bridge engineer for the Oregon State Highway Department; bridge engineer on the Columbia River highway project; and engineer for the U.S. Bureau of Public Roads, with headquarters in Portland. He was a graduate of the University of Nebraska, class of 1906. A member of the ASCE since 1916, Mr. Purcell was elected to honorary membership in 1945.

Charles H. Purcell

Andrew Weiss

Irrigation and the development of irrigation projects were the predominant interest of Andrew Weiss, Honorary Member of the Society, who died in Mexico City on September 2. His age was 84. A graduate of the Colorado School of Mines, class of 1899, he was with the U. S. Reclamation Service from its formation until 1924, working on the Salt River Project in Arizona, the North Platte Project in Wyoming, and as Assistant Director of Reclamation Economics. In January 1926 he became connected with the J. G. White Engineering Corp., of New York, on construction of irrigation works in Mexico under the supervision of the National Irrigation Commission of Mexico. He directed building of the Don Martin Irrigation

Andrew Weiss

System and of the Conchos Project, and in 1932 became consulting engineer to the National Irrigation Commission of Mexico on all projects under its construction. He later was advanced to the position of chief of the Technical Consulting Division on construction of reclamation and drainage works. Under him the activities of the Commission were greatly enlarged. Becoming a full Member of ASCE in 1917, Mr. Weiss was made an Honorary Member in 1948.

Coming Events

Arizona—Meeting in Phoenix on November 23 and 24.

Buffalo—Meeting at the Buffalo Athletic Club, October 16, at 12:15 p.m.

Central Illinois—Dinner meeting at the Jefferson Hotel, Peoria, on November 6, at 7 p.m.

Central Ohio—Dinner meeting at the Chittenden Hotel, Columbus, October 18, at 6:15 p.m.

Cleveland—Dinner meeting at the Cleveland Engineering Society on October 19, at 6:15 p.m.

Los Angeles—General dinner meeting at the Alexandria Hotel, Los Angeles, October 10, at 6:45 p.m. Fall banquet of Junior Forum at Scully Cafe, Los Angeles, October 25, at 7 p.m.

Maine—Joint meeting with Maine Association of Engineers, at the Augusta House, Augusta, on November 3.

Maryland—Meeting at the Engineers Club of Baltimore, October 10, at 8 p.m., preceded by cocktails at 6 p.m. and dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building on October 17, at 8 p.m. Junior Branch meeting in the ASCE Board Room on October 10, at 8 p.m.

Mid-South—Dinner meeting of Jackson Branch of Section at Hotel Heidelberg, Jackson, October 25, at 7 p.m.

North Carolina—Annual meeting in Greensboro on October 12.

Pittsburgh—Joint meetings with civil section of Engineers Society of Western Pennsylvania at the Hotel William Penn on October 16 and 30, at 8 p.m.

Sacramento—Joint meeting of the Section, the Sacramento Junior Forum, and the University of Nevada Student Chapter, in Reno, Nev., on November 10. The meeting will be directed toward publicizing the ASCE Centennial. Tour of campus and Reno, 2 to 5 p.m.; cocktail hour, 6 to 7 p.m.; dinner at Hotel Mapes followed by program arranged by local members and Student Chapter. On Sunday at 9 a.m. excursion will leave for Steamboat Springs, Bowers Mansion, and Virginia City.

St. Louis—Luncheon meeting at the York Hotel, St. Louis, October 22, at 12:15 p.m.

Virginia—Fall meeting at the Hotel Roanoke, Roanoke, on November 9.

West Virginia—Annual meeting of Section has been postponed from October 5 and 6 to November 16 and 17. Meeting place the Daniel Boone Hotel in Charleston.

EJC Approves Affiliation with UPADI

Engineers Joint Council has received the approval of a majority of its member bodies to become an adherent of the Federation of Pan American Engineering Societies, known as UPADI from its Spanish name, Union Panamericana de Asociaciones de Ingenieros. EJC has given enthusiastic support to the concept of a Pan American organization since its origin and participated in the initial phase of its formation at Rio de Janeiro in July 1949 when the representatives of engineering societies in the Americas met in a First Pan American Engineering Congress. UPADI held its first meeting in Havana in 1951 and agreed on a draft Constitution, which was to govern until the next meeting to be held in New Orleans in the late summer of 1952. (See May issue, page 59.)

The United States is one of nine nations designated to furnish a member to the first UPADI Board of Directors. James M. Todd has been appointed U.S. member of the UPADI Board, and S. L. Tyler will represent the United States on the permanent UPADI Committee on Constitution and By-Laws.

President Hathaway Visits Puerto Rico Section

PRESIDENT HATHAWAY is greeted on arrival at Isla Grande Airport, Puerto Rico, by group of members and officers of Puerto Rico Section. Shown here, left to right, are Carl Bock; Milton Mortimer; William McFarland, vice-president of Section; ASCE Director Edmund Friedman, of Miami, Fla.; Antonio Luchetti; Mr. Hathaway; William C. Hill, secretary-treasurer of Section; and M. A. Quinones. Mr. Hathaway's three-day visit included attendance at business meeting of Section and at convention at Colegio de Ingenieros.

NEWS BRIEFS . . .

August Construction Activity Remains at July Level

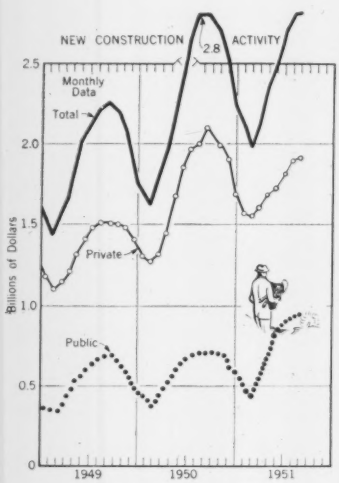
Expenditures for new construction in August totaled $2.8 billion, about the same as in July, according to joint preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the Department of Commerce. Although the dollar volume of new construction for the month was only slightly under the August 1950 total, it represents a significantly smaller physical volume of work put in place when adjusted for the increase in construction costs.

A contraseasonal decline of 2 percent in private residential building and an 11 percent drop in commercial building during the month reflect the continued effects of building restrictions, according to the joint agencies. Private homebuilding for the month showed a decline of about 33 percent from the August 1950 total, and commercial building a decline of 6 percent. Private industrial building increased 4 percent over July and was double the dollar volume for last August.

Although total expenditures for new private construction were down fractionally from July to $1,865 million, the decrease was more than offset by a 4 percent rise to $937 million for public construction. The joint agencies attribute most of the rise in public expenditures to atomic energy and military projects and to highway construction.

Construction of military facilities, industrial plants, electric power projects, and other defense facilities continued to rise in August as rapidly as available supplies of structural steel, copper, and other scarce materials would permit. Expenditures for military construction were six and a half times greater than the level of a year ago, while industrial plant building (both private and public) had more than doubled.

New construction expenditures for the first eight months of 1951 totaled $19.5 billion, almost 12 percent over the comparable period in 1950. Private new construction, valued at $13.7 billion, was up 5 percent over last year and new public construction totaling $5.8 billion was up by 31 percent.



DEPARTMENT OF COMMERCE curves show August construction activity at near July level and well below physical volume of August 1950 work. Decline is attributed to effects of building restrictions.

Structural Steel Allotments for Fourth Quarter Announced by NPA

Only the direct military expansion program of the country and aluminum expansion (in the metals expansion program) have been granted full allotments of structural steel requested for the fourth quarter of 1951, according to data released by the National Production Authority. As requested, the Army will receive 4,059 tons, the Navy 7,306 tons, and the Air Force 31,273 tons. An additional commitment that will raise the total tonnage for the military program from 42,638 tons to 60,000 tons has been announced, but the projects for which it will be earmarked have not been decided.

Though the aluminum expansion program has been granted the full amount of 19,010 tons of structural steel requested, the iron and steel expansion program will receive only 51 percent of its request or 89,468 tons. General commercial construction has been granted 12,055 tons, which is only 11 percent of the 106,574 tons requested.

The following tabulation indicates in tons the amounts of structural steel requested by delegate agencies from the Defense Production Administration and the amounts allotted them.

Program	Stated Requirements	Allotment	Percentage
Atomic Energy Commission	35,000	35,000	100
Defense Electric Power Administration	161,944	120,000	75
Office of International Trade	100,633	25,000	25
Federal Security Agency (Schools and Hospitals)	139,531	68,000	40
Maritime Administration	19,776	15,000	76
Department of Defense	207,845	194,757	94
Petroleum Administration for Defense	102,123	60,000	59
Bureau of Public Roads	232,793	100,000	43
Defense Minerals Administration	12,670	7,000	55
Defense Transport Administration	104,553	30,000	29
Housing and Home Finance Agency	34,034	17,000	50
Secretary of the Army (Domestic Construction)	15,202	14,000	90
NPA (Canadian Division)	64,281	50,000	77

New York City to Have Second Avenue Subway

A $500,000,000 program for expansion of the New York City rapid transit system by construction of a Second Avenue subway has been unanimously endorsed by the Board of Estimate. As prepared by the Board of Transportation, the program includes connections linking the proposed facility to existing lines in Manhattan, Brooklyn, Queens, and the Bronx. It is now under study by the City Planning Commission. Construction is to be completed in five years except for one connecting link.

Part of the city's long-range transit-improvement program, the project is based upon a six-track trunk-line subway under Second Avenue from Grand Street, Manhattan, to 149th Street and Third Avenue, the Bronx. It involves purchase of the Rockaway Beach branch of the Long Island Railroad for rehabilitation and operation as a unit in the municipal transit system, and ultimate acquisition of other links of the Long Island Railroad. Conversion of the present two-track section of the Sixth Avenue subway between Fourth and Thirty-Fourth Streets into a four-track line to permit operation of more trains between Brooklyn and Manhattan is also involved. In addition, the plan calls for improvements in the existing system by elimination of bottlenecks and rearrangement of service.

Financing the project depends upon adoption by the voters of the state of a pending constitutional amendment granting debt-limit exemption to $500,000,000 of city bonds to be issued for financing transit improvements.

Ohio and Utah Cities to Have New Sanitation Facilities

Interest-free advances totaling $239,780 have been approved by the Housing and Home Finance Agency to assist the cities of Zanesville, Ohio, and Salt Lake City, Utah, in the preparation of plans and engineering drawings for essential sanitation projects to cost an estimated $7,491,600.

An advance of $149,780 for Zanesville will help cover the costs of planning intercepting sewers and a 10-mgd sewage-treatment plant. The proposed new facilities are intended to help integrate the existing system now serving the various parts of the city, and to eliminate pollution of the Muskingum and Licking rivers. They will cost an estimated $4,596,000.

Salt Lake City is receiving $90,000 to finance the planning of a 52,800-ft gravity outfall sewer, together with 42,240 ft of trunk line and lateral sewers. This project, which is needed to relieve the overload on the city's present sewerage system, is estimated to cost $2,895,600.

Philadelphia Opens New Schuylkill River Bridge

The new Penrose Avenue Bridge over the Schuylkill River in southwest Philadelphia was formally opened to traffic on September 12 in ceremonies attended by national, state, and city officials. In the principal speech Mayor Bernard Samuel said the bridge will make it possible to reach the International Airport from the center of the city in ten minutes.

Built at a cost of $13,700,000, the 2½-mile span is said to be the largest built in the city since erection of the Tacony-Palmyra Bridge in 1929. It replaces the old Penrose Avenue ferry drawbridge. An article describing the project, by Frank M. Masters, M. ASCE, member of the Harrisburg, Pa., firm of Modjeski & Masters, designers, appears elsewhere in this issue. The bridge was built by the Philadelphia Department of Public Works.

Salt Water Invasion of California Coast Continues

Ocean water is continuing to intrude into important agricultural areas of the coastal part of Orange County, California, according to recent studies of the U. S. Geological Survey conducted in cooperation with the Orange County Water District and the Orange County Flood Control District. In announcing availability of a report of current investigations of the cooperating agencies into the coastal contamination problem, the Department of the Interior notes that in Santa Ana Gap 530 acres have been underrun by ocean water since 1944 and that the contamination front is proceeding inland from 700 to 1,000 ft a year.

Emphasized in the report is the direct relation between continued lowering of groundwater levels caused by subnormal rainfall and unprecedented demand for water from wells, and the tendency of ocean water to migrate inland in response to the resulting inland hydraulic gradients within the coastal ground-water aquifers. Pending release of the report for limited public distribution, copies may be examined in U. S. Geological Survey offices in Washington, D. C., and Sacramento and Long Beach, Calif., and in offices of the cooperating agencies at Santa Ana, Calif.

New Company to Advance Asphalt Products Sales

Formation of a nationwide company for the manufacture and sale of various types of paving asphalts and special asphalt products is announced by the American Bitumuls & Asphalt Co. Formerly operating only in the territory east of the Rocky Mountains, the company is acquiring the assets of the Stancal Asphalt & Bitumuls Co., which has operated in the west. Both are subsidiaries of the Standard Oil Company of California. Headquarters for the new organization will be 200 Bush Street, San Francisco, Calif.

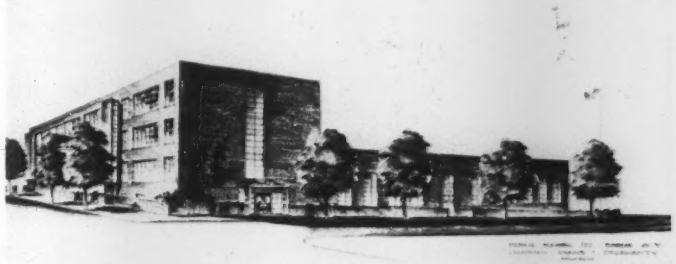
Contract for Large Aircraft Plant Given

With recent award of a contract to the Turner Construction Co., of New York, and the Barton-Malow Co., of Detroit, for an addition to the existing plant of the Ford Motor Co. at Ypsilanti, Mich., work will soon get under way on construction of a large story-and-a-half structure for the production of aircraft engine fuel injection systems. Albert Kahn Associated Architects and Engineers will design the building, which will contain more than 400,000 sq ft of floor space and cost approximately $6,000,000.

N.Y.C. Turns to Reinforced Concrete Schools

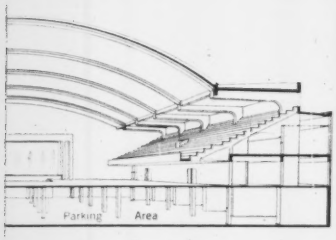
Faced with both the immediate need for more schools and government edicts limiting supplies of structural steel, the New York City Board of Education has adopted the use of reinforced concrete for its school buildings. The only exception will be auditoriums and gymnasiums in which long spans are required. The step promises to save more than 50 percent of the steel that would have been required in all-steel schools. There does not seem to be any appreciable difference in cost between the two types of structures in the metropolitan area.

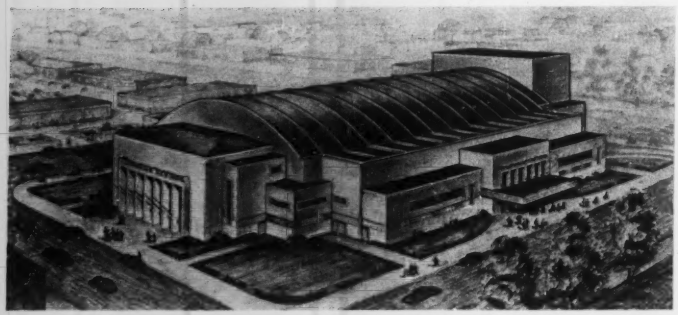
The school-building program has stepped up from twelve new schools in 1949 and 1950 to 31 new elementary and junior high schools in 1951. Estimated cost of the program is $37,000,000. The structures range in cost from $400,000 to $2,750,000. Of the 31 schools, 16 involving expenditure of $21,000,000 are being designed by private architectural firms, and the remainder by the Construction Division of the Board of Education. Design of a few of the schools had already been started when the decision to use reinforced concrete was made and because of tight schedules they were left steel structures. Though no difficulties have arisen regarding the allocation of reinforcing steel and the scheduling of construction, a few occasions have cropped up where manufacturers have refused to honor allocations. The coordinator of the entire construction program is John P. Riley, M. ASCE.



TYPICAL OF STRUCTURES being built by New York City Board of Education is this public school of reinforced concrete. Swing to reinforced concrete followed governmental restrictions on allocation of structural steel. This school was designed by Chapman Evans & Delehanty.

Unique Construction Characterizes Syracuse, N.Y., War Memorial





USE OF ARCH IN CANTILEVERED WALL CONSTRUCTION features $4,000,000 multi-purpose structure dedicated in Syracuse, N.Y., on September 12 as memorial to Onondaga County war veterans. Arched roof has span of 160 ft, with rise of 28 ft, and is supported by a 25-ft cantilever from buttresses on each side. Arch spring line is 36 1/2 ft above the ground. Building is 334 1/2 ft long and 242 ft wide, with unobstructed main auditorium 250 ft long by 138 ft wide. Constructed under direction of special commission set up by state legislature, project is being financed by 20-year bond issue. Architects were Edgarton & Edgarton of Syracuse. Ammann & Whitney of New York were structural consulting engineers, and Robson & Woese, Inc., of Syracuse, mechanical consulting engineers. General contractor was the W. E. O'Neil Construction Co., Inc., of Chicago.

New Bridge to Span Ohio at Wheeling, W. Va.

Construction of a four-lane bridge across the Ohio River on U.S. Route 40 at Wheeling W.Va., will start following recent award by the West Virginia State Road Commission of a $877,082 contract to the Dravo Corporation, of Pittsburgh, Pa., for construction of four main river pier foundations for the bridge. The new structure is expected to relieve the strain of heavy traffic over the historic Wheeling suspension bridge 600 ft downstream from the site of the new structure. Separate bids will be requested later for the land piers and approaches.

Says Construction Controls Cause Building Shutdown

The gradual shutdown of building construction in New York City and consequent widespread unemployment forecast by leaders in the building industry is becoming a reality under controls and restrictions imposed by the National Production Authority, according to Fred J. Driscoll, president of the Building Trades Employers' Association.

Citing the August issue of the Labor Market Letter of the State Department of Labor, which reported that the "construction work force in New York City is at a standstill, with employment 10,000 below last year, although expansion is the rule in warm weather, "Mr. Driscoll asserted that, "With virtually no defense construction underway and little in prospect, the building industry in New York City is being choked to death under NPA controls."

As a measure of the decline in building construction, Mr. Driscoll pointed to the total of only $118,000,000 in commercial construction authorized by Washington and the New York regional office of the NPA in the first half of 1951. This total of $118,000,000," he said, "is for the entire states of New York and New Jersey. Compare this figure with the average yearly construction volume of $425,000,000 in the five boroughs of New York City alone.

"Under the new Order M4A and the NPA Controlled Materials Plan, multi-story family apartment developments and commercial construction are the hardest hit. The order virtually prevents the start of any new multi-family housing, which in recent years has been the backbone of the building industry in New York. The industry faces serious dislocation and a complete breakdown of its essential teamwork. Our skilled craftsmen, who set production records in recent years, will be forced to drift to other cities in search of employment."

Plans Authorized for Hudson River Bridge at Kingston

Under a recent contract with the New York State Bridge Authority, D. B. Steinman, M. ASCE, New York City consultant, has been authorized to furnish complete engineering services for the Kingston-Rhinecliff Bridge over the Hudson River, which will cost approximately $20,000,000. These services will include surveys, design, preparation of contract drawings and specifications, and supervision of construction.

Carrying a clear-vision, four-lane roadway, the bridge will be a continuous-deck structure, 7,580 ft in length, with 800-ft spans over two river channels. It will be an important traffic link, connecting the New York State Thruway on the west side of the Hudson with the Taconic State Parkway and other vital routes in the section on the east.

Plans for the bridge have been approved by the War Department and the Secretary of Defense. It will be built and operated under the sponsorship of the New York State Bridge Authority, of which James F. Loughran, Assoc. M. ASCE, is chairman. Completion is planned for sometime in 1953.

Steel Producers Seek Additional Scrap

Another urgent plea for iron and steel scrap is being made by the steel companies, according to the American Iron and Steel Institute. In particular, industrial and agricultural consumers of iron and steel products and machinery and equipment are urged to collect unused, broken, or obsolete items and sell them to scrap dealers.

Pointing out that more scrap is needed than ever before if production levels are to be maintained and increased, the Institute notes that stockpiles were seriously depleted by mid-summer when the industry would normally begin to increase its inventories for the winter months. Last year the steel-making furnaces of the country consumed a record 53.7 million tons of scrap, nearly 14 percent more than in the previous record year of 1948.

Contractors' Problems Studied at Meeting of AGC

The complex problems involved in carrying out defense and essential civilian construction under a controlled economy were studied by representatives of the Associated General Contractors of America at the mid-year meeting of its governing and advisory boards held in Chicago early in September. The attendance of more than 300 represented the nation's leading contracting firms. Also meeting in conjunction with the sessions was the Joint Cooperative Committee of ASCE and AGC, which is reported elsewhere in this issue.

Lengthy discussion was devoted to the various controls on construction operations and on wages. Other specific subjects discussed included the administration and effects of the controlled materials plan on construction; the effect on contractual relationships of project delays due to lack of controlled materials; possible price controls over the industry; legislation affecting construction; market development; accident prevention; apprentice training; and public relations.

In opening the meeting, President Glen W. Maxon stated that it was the duty of members, through the AGC, to point out any serious effects of controls upon their businesses and their clients, and to report to the association on local effects as fully as possible. Calling for good administration of the controlled materials plan "if a terrible mess is to be avoided in the construction industry," Mr. Maxon emphasized that, "The best intelligence of government and all the ingenuity of general contractors will be needed to complete essential projects with a minimum of delay and without extra expense."

In a review of major legislation enacted or pending, Arthur S. Horner, Assoc. M. ASCE, vice-president of AGC, reported the Legislative Committee sees recent criticism directed at the Corps of Engineers being used as an "entering wedge" by groups seeking legislation for more valley authorities patterned after the Tennessee Valley Authority. He reaffirmed the consistent stand of AGC against such legislation.

Highway and Airport Construction

In a spirited round-table discussion conducted by highway and airport contractors, the problem of increasing steel allotments for highway construction was a prime topic. It was the consensus of the group that while the Bureau of Public Roads is doing "a good job in general" of processing applications for highway construction, NPA officials are "not aware of the great importance of highways and highway transportation to the nation's economy and to national defense." The contractors urged that state highway departments and local groups, such as good roads associations, make known their views of the "grave danger facing highway transportation" to government officials at every level.

Considerable progress was reported in obtaining state adoption of emergency termination clauses in construction contracts, with five states reported to have passed special laws making this possible, and twelve others already using such clauses.

The group also recommended action by the Civil Aeronautics Administration toward easing the "very severe and unrealistic" requirements specified for compaction on airport construction. It was pointed out that, although construction under the federal airport program will be limited this year, there remains almost a billion dollars of airport work to be done in the next five years.

Officers for 1952 Nominated

Officers nominated by the governing boards for 1952 are Arthur S. Horner, Assoc. M. ASCE, of the A. S. Horner Construction Co., for president, and C. P Street, of McDevitt & Street Co., Charlotte, N.C., for vice-president. Installation of new officers will take place at the close of the AGC annual convention, scheduled for Detroit, Mich., February 25–28, 1952.

Film on Water Supply Available Through G.E.

As part of its "More Power to America" series, aimed at increasing the nation's productivity through a broader utilization of electric power, General Electric has launched a visual program designed to increase awareness of the growing threat of water shortages and to enlist support behind community water works projects. The program features a 25-minute, full-color, sound motion picture, "Pipeline to the Clouds."

Dramatizing the importance of water to the individual and his community, the 16-mm film outlines the need for immediate action to combat potential shortages and to assure safe, adequate supplies. It was produced by the Raphael G. Wolff Studios in Hollywood, with the technical assistance of the American Water Works Association and the U. S. Public Health Service.

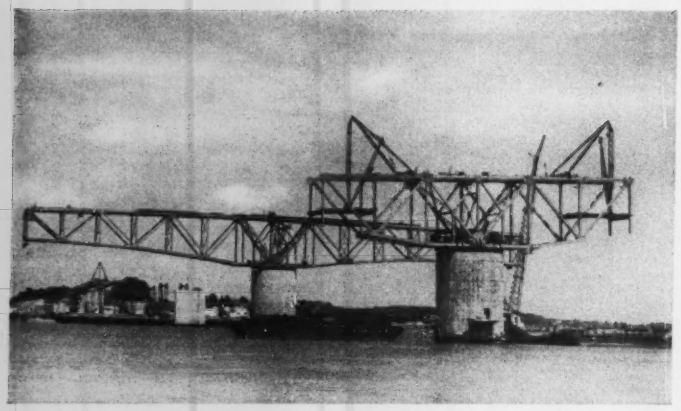
The film may be borrowed from General Electric, Schenectady, N.Y., without charge.

Los Angeles Builds Large Underground Parking Garage

© *"Dick" Whittington*

CONSTRUCTION OF UNDERGROUND GARAGE PROJECT, which is being built under historic Pershing Square in downtown Los Angeles, is about 20 percent completed. Three-story project will provide 630,000 sq ft of floor space and parking capacity for 2,000 cars, making it the largest structure of its kind in the world. Emergency use of project as defense shelter is also planned. Unusual system of ramps will permit emptying entire building in less than half an hour. All exterior ramps will pass under sidewalks to avert the possibility of danger to pedestrians. Cost of project, which is about $5,000,000, is being financed by private capital. Under study for several years by Los Angeles Department of Recreation and Parks and Downtown Business Men's Association, project is under supervision of syndicate called City Park Garage, Inc. Architect-engineer is Stiles Clements, and joint venturers are Ford J. Twaits Co., Morrison-Knudsen Co., Inc., and T. S. Construction Engineers, Inc. Charles A. McMahon, Assoc. M. ASCE, is superintendent for City Park Garage.

Construction of York River Bridge Nears Completion



MASSIVE FOUNDATIONS OF THE $8,000,000 George P. Coleman Bridge, now under construction by Virginia Department of Highways over the York River between Yorktown and Gloucester on U.S. 17, are nearing completion. The six large caissons, which form the base of the river piers, were sunk 40 ft below water surface and from 60 to 70 ft below river bottom in difficult engineering operation that began last March. Now substructure is 97 percent, and superstructure approximately 60 percent complete. Main steel for the first of two 500-ft swing spans, which will provide 450-ft clearance and constitute the largest double-swing spans ever assembled, has already been erected. All approach girder spans have been in place for several months, and work will soon begin on main river spans. Completion is expected by early spring. Consulting engineers on project are Parsons, Brinckerhoff, Hall & Macdonald, of New York. Contractors for substructure are Massman Construction Co., of Kansas City, and the Kansas City Bridge Co., and for the superstructure, the Virginia Bridge Co., of Roanoke.

Fellowships in Public Health Field Announced

The World Health Organization is making available to the United States from ten to fourteen fellowships for foreign study in public health or allied fields for 1952. Applicants must be engaged in full-time public health or educational work, and must have knowledge of the language of the country to be visited. Stipends range from $160 to $300 a month, with the World Health Organization providing transportation across the ocean and in the country visited.

Applications must be filed in triplicate by January 1, 1952. Blanks may be obtained from the Division of International Health, U. S. Public Health Service, Washington, D.C.

Engineers at Lima, Peru Establish Technical Club

Recent organization of an "International Engineers Club" at Lima, Peru, for the purpose of promoting technical and professional exchange of information among engineers and other members of international technical and scientific societies in the area is announced by Henry F. Stubbs, M. ASCE, member of the Program Committee and West Coast manager for the Frederick Snare Corp. Other members of the committee are Norman B. Wood, Assoc. M. ASCE, chief of the Highway Mission to Peru of the U.S. Bureau of Public Roads, and don Fernando Fuchs, Peruvian mining engineer.

There will be monthly luncheon meeting with technical speakers as well as a social program. The present membership consists of about 30 Peruvian, British, and American engineers.

Springfield, Mass., to Have New Municipal Hospital

The old Springfield, Mass., Municipal Hospital for indigent patients will be rebuilt by the Thompson-Starrett Co., Inc., of New York, which was recently awarded a contract for the project. The approximate cost of construction will be $5,515,000. Designed by the Boston architect-engineer firm of Coolidge, Shepley, Bulfinch & Abbott, the project will include a six-story main building containing a children's rehabilitation center, operating and laboratory rooms, and two wards for 234 patients, with provision for 100 additional beds.

Philadelphia Plans Major Improvement Program

A far-reaching program of public improvements for Philadelphia, to be undertaken between 1952 and 1957 at a cost of $558,468,396, has been presented to the mayor by the Philadelphia City Planning Commission after review by the various city departments concerned. The program, which is expected to modernize large areas of the city's physical appearance and facilities, is the first to be prepared under the Philadelphia Home Rule Charter.

In presenting the program to the mayor, Edward Hopkinson, Jr., chairman of the City Planning Commission, stated, "Much of this tremendous program is already under way, much has already been completed, and the new developments scheduled for the next six years . . . will enable the city to meet the demands now being forced on it by the present amazing rate of growth and will improve sections that have been depreciated by age."

The present improvement program includes the following scheduled projects, some of which are already under way: Complete construction of the $80,000,000 Schuylkill Expressway and the Roosevelt Boulevard and Vine Street extensions; construction of the first link of the Delaware Expressway from Penrose Avenue Bridge across South Philadelphia to the new Delaware River crossing in the vicinity of Oregon Avenue; bridge and highway improvements throughout the city; the transit and related improvement program; rebuilding in the heart of the city, including Independence Mall, and the removal of the "Chinese Wall"; completion of the $69,000,000 sewage-treatment program; and a $29,600,000 program for further improvement of the quality and quantity of Philadelphia water.

Construction Legislation Enacted by Congress

A bill appropriating construction funds for the Department of the Interior for the 1952 fiscal year has been enacted by Congress. Major appropriations include:

	1952 (In Millions of Dollars)	1951 (In Millions of Dollars)	Per-cent of Change
Bonnevile Power Administration	$ 67.5	$ 44.6	+51%
Southwestern Power Administration	3.4	8.6	−60%
Bureau of Reclamation	202.8	243.7	−17%
Bureau of Indian Affairs	7.	23.	−70%
Alaska Railroad	2.	13.	−84%

2 New Developments

that mean LOWER COST REINFORCED CONCRETE

1. New A. C. I. Building Code

2. New A305 Reinforcing Bars

Early this year, the American Concrete Institute revised its building code requirements to take advantage of the benefits made possible by the new A305 reinforcing bars. Under the new code standards, these bars increase allowable bond stresses, reduce lapping at splices, and practically eliminate hook anchorage. They provide even stronger reinforced concrete structures at lower cost. In order for *you* to share in these benefits, your local code must be revised to conform to the new A.C.I. standards.

CONCRETE REINFORCING STEEL INSTITUTE
38 S. Dearborn St., Chicago 3, Ill.

AISC Gives Awards for Beautiful Steel Bridges

Award of stainless steel plaques for three bridges selected as "the most beautiful steel bridges opened to traffic in the United States during 1950" is announced by the American Institute of Steel Construction. The prize-winning structures in the contest, which has been conducted annually by the Institute since 1928, were selected from a field of 97 entries, more than double last year's entries.

In Class I, for bridges with spans of 400 ft or more, the award goes to the Columbia River Bridge at Wenatchee, Wash. Owned by the State of Washington Department of Highways, the structure was designed by George Stevens, Assoc. M. ASCE, bridge engineer for the department, and fabricated by the American Bridge Co.

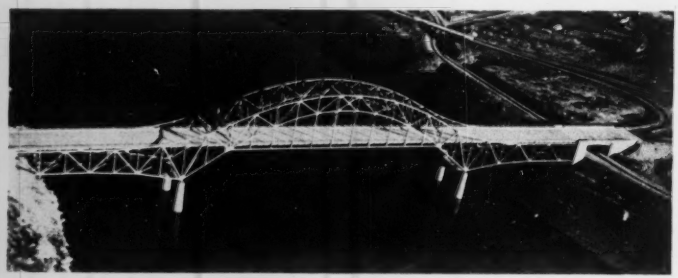
The South Holston River Bridge on Tennessee State Highway 34 was winner of the Class II award for bridges with spans under 400 ft, costing over $500,000. Designed by the Tennessee Valley Authority and fabricated by the Virginia Bridge Co., the bridge is owned by the State of Tennessee.

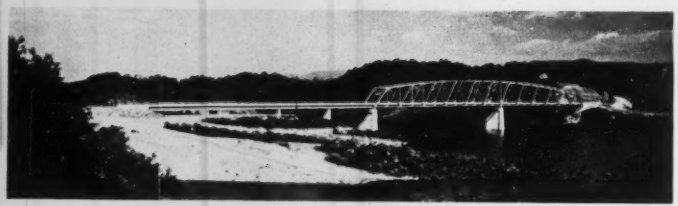
In Class III, for bridges with spans under 400 ft, costing less than $500,000, the award goes to the Caldwell Avenue Bridge over Edens Expressway, Cook County, Illinois. The bridge was designed by the Cook County Highway Department, for which J. Edward Quinn is architect, and fabricated by the Bethlehem Steel Co. Cook County is the owner.

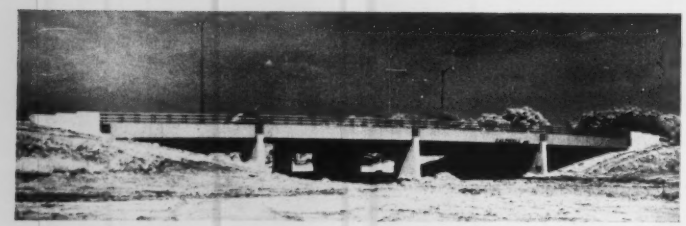
In Class I, honorable mention (for steel design) was given to the A. Piatt Andrew Bridge on Route 128 over the Annisquam River in Gloucester, Mass. Owned and designed by the Massachusetts Department of Public Works, the bridge was fabricated by the Bethlehem Steel Co.

Two bridges received honorable mention in Class II—the Yazoo River Bridge on U.S. Highway No. 61, north of Vicksburg, Miss., and the G. H. & S. A. Railroad Overpass, the Gulf Freeway in Harris County, Texas. Designer of the former structure was Charles S. Hill, bridge engineer for the Mississippi State Highway Department, which is the owner. The truss spans were fabricated by the Virginia Bridge Co., and the approach spans by the Bethlehem Steel Co. Owned by the State of Texas, the G. H. & S. A. Railroad Overpass was designed by the Texas Highway Department and fabricated by the Virginia Bridge Co.

Four bridges received honorable mention in Class III: Route 4 Parkway Overpass at Route 25, Middlesex County, New Jersey (owned and designed by the New Jersey State Highway Department, under Morris Goodkind, Director ASCE, director and chief bridge engineer for the Division of Bridges, and fabricated by the Phoenix Bridge Co.); the Manitou Road Barge Canal Bridge in Monroe County, New York (owned by the New York State Department of Public Works and designed in the Office of the Deputy Chief Engineer of the department, and fabricated by the Phoenix Bridge Co.); the Swatara Creek Bridge on the Eastern Extension of the Pennsylvania Turnpike (owned by the Pennsylvania Turnpike Commission, designed by Modjeski & Masters, of Harrisburg, and fabricated by the Harris Structural Steel Co.); and the Niles Street Pedestrian Overpass, relocation of Route 2 in Leominster, Mass. (owned and designed by the Massachusetts Department of Public Works and fabricated by the American Bridge Co.).







PRIZE-WINNING BRIDGES IN ANNUAL AISC COMPETITION are (top to bottom) Columbia River Bridge at Wenatchee, Wash. (Class I); South Holston River Bridge on Tennessee State Highway 34 (Class II); and Caldwell Avenue Bridge, over Edens Expressway, Cook County, Illinois (Class III).

Contract for Construction of Folsom Dam Awarded

Start of preliminary work on a dam more than two miles long on the American River at Folsom, Calif., following award of a $29,444,000 joint contract to the Merritt-Chapman & Scott Corp., of New York, and the Savin Construction Corp., of Hartford, Conn., is announced by the Sacramento District Office of the Corps of Engineers.

Part of an over-all project for development of the American River Basin area, the dam will provide flood-control protection, irrigation, and power. Excavation for the power plant is now underway by the Bureau of Reclamation under a separate contract. Approximately 340 ft high, the dam will provide storage capacity for about 1,000,000 acre-ft of water. Its main concrete section astride the American River will be 1,400 ft long, with rock and earth embankments on either side extending its over-all length to more than two miles.

Kellex Corp Changes Its Name

The Kellex Corp., research and engineering firm, announces that it has changed its name to the Vitro Corporation of America. Organized in 1943 as a subsidiary of the M. W. Kellogg Co., the Kellex Corp. engineered the gaseous diffusion plant at Oak Ridge, Tenn., and has designed major production facilities for the atomic plant at Hanford, Wash. Main offices of the corporation will remain at 233 Broadway, New York City, and the research and development laboratories in West Orange and Jersey City, N. J., and Silver Spring, Md.

4 reasons why CONCRETE PIPE gets the call for sewers

FROM giant trunk line installations to small diameter sanitary sewers concrete pipe is the choice of leading sanitary engineers from coast to coast when specifying pipe for sewers. There are four sound engineering reasons for this nation-wide preference:

1. AMPLE STRENGTH. Concrete pipe is so rugged it is able to resist severe impact, sustain heavy overburdens and withstand the wearing action of severe climatic or soil conditions.

2. OUTSTANDING DURABILITY. When you specify concrete pipe you assure long years of trouble-free operation. Many cities have had over a century of service from concrete pipe sewers.

3. MAXIMUM HYDRAULIC CAPACITY. The smooth interior walls and clean, even joints of concrete pipe resist abrasion from suspended matter and provide maximum carrying capacity.

4. UTMOST SAFETY. Concrete pipe's uniformly dense structure and tight joints assure minimum leakage and infiltration, thus helping to reduce contamination along the line and the overloading of sewage treatment plants.

Engineers and taxpayers also prefer concrete pipe sewers for their economy. They are moderate in first cost and serve far longer with little or no maintenance. The result is ***low-annual-cost*** sewer service—the true measure of pipe line economy.

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Committee Will Advise on Modular Coordination

An advisory committee has been formed by the Housing and Home Finance Agency to expedite development of a research program on modular coordination in housing construction now being conducted under the supervision of the agency's Division of Housing Research. This broad research program directed toward economies attainable through adoption of a standard unit of measurement in housing materials and design, is currently putting main emphasis on problems related to national defense.

In announcing formation of the Advisory Committee on Modular Coordination, HHFA Administrator Raymond M. Foley said that its advice will first be sought on a project aimed at development of a guide for the dimensional standardization of building elements and components based on the 4-in. module. The project will be handled for the HHFA under the contract by the Illinois Institute of Technology.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"Well, Flo," began Professor Neare, "it's time to plunge into your Demiluna Pool problem. I wouldn't expect too much from Joe Kerr, because he can't graph it without the unknown diameter."

"Probably so," agreed Guest Professor Flo Ridan. "It was given that connected chords 73, 37 and 47 ft long closed on a diameter which was also an integer, and graphical analysis is not adapted to problems in whole numbers."

"Says Flo, not Joe," said Joe. "I'll show you. The semicircular arc must exceed the combined chord length of 157 ft, so the diameter is at least 100 ft. Guessing 105, I drew a semicircle, struck off the chords in order and overran the diameter. Next I tried 107 and underran. So d had to be 106, which I checked with a third trial. Time: 2^m 41^s. But if you hadn't hinted that d was an integer, I'd have wasted an hour with trig tables."

"Tables aren't needed," argued Ken Bridgewater. "The cubic

$$d^3 - d(a^2 + b^2 + c^2) - 2abc = 0 \quad \ldots\ldots (1)$$

expresses the condition that chords a, b and c close on d, whence

$$d^3 - 8{,}907d - 253{,}894 = 0 \quad \ldots\ldots (2)$$

for the given values of the chords. Since the only positive root is 106.282 ft, maybe this equals 39.00 varas in Florida."

"Wishful thinking, if any," commented Cal Klater. "Ken's equation has the factor $d + 74$, giving a negative integer for a root. But 74 is a positive root of

$$d^3 - 8{,}907d + 253{,}894 = 0 \quad \ldots\ldots (3)$$

obtained from (1) if either a, b, or c is negative. Hence $d = 74$ ft and the shortest chord is recessive, so that the figure is a doubly reentrant or crossed quadrilateral, as shown in the figure."

"Quite right, Cal, and the digits of the four sides are crossed in pairs as well, making the problem a double cross. Anything to add, Noah?"

"Just this, Flo, that it is easy to derive an infinite number of such combinations of integers satisfying (1). If any square is expressed as the product of four factors, $p{\cdot}q{\cdot}r{\cdot}s$, such that $p > q$ and $r > s$, then two sets are given by:

$$\begin{aligned} a &= (p + q)(r - s) \\ b &= (p - q)(r + s) \\ c &= 4\sqrt{pqrs} \pm (p - q)(r - s) \\ d &= (p + q)(r + s) \end{aligned}$$

The set with the larger c has a crossed figure, the lesser of a or b being recessive. The other set has a salient figure unless c itself is negative. The demiluna set is generated by $p = 3$, $q = 1$, $r = 147$, $s = 1$, which also derives the set 73, −26, 37, 74.

"I wonder how many of you ever heard of Hy Drone, the lazy hydraulician? Some say he avoided work without dodging it, but anyway he built a canal with a special section so that he could forget the Manning formula. It had a low-water section of 1.0 sq ft, a high-water section of 100 sq ft and flowed at the same velocity for any intermediate stage, this velocity being the maximum possible for the slope. What shape was the canal in?"

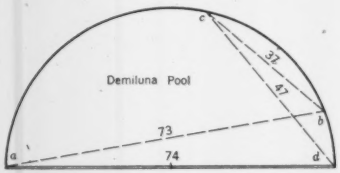

FIG. 1. THE 74-FT POOL is traversed with even-foot chords.

[*Cal Klaters were: Richard Jenney, Charles W. Trigg, John L. Nagle, Marvin A. Larson, Laurence V. Degnan, and S. L. Dum (Thomas M. Borman). Guest Professor Flo Ridan was Charles G. Edson.*]

DECEASED

Memorial Service Arranged for Dugald C. Jackson

Friends of the late **Prof. Dugald C. Jackson** [obituary, August issue, page 76] have arranged a memorial service in his honor at the First Congregational Church in Cambridge, Mass., at 11 Garden Street, on Sunday, October 21, at 4 p.m. An open invitation is extended to all who wish to attend.

Claris Allen (Assoc. M. '44) assistant chief engineer for the Indianapolis Water Co., Indianapolis, Ind., died there on August 30, at the age of 46. In 1930 Mr. Allen joined the water utility as assistant engineer, becoming principal engineer in 1944 and assistant chief engineer in 1950. Earlier he served the Corps of Engineers in Peoria, Ill. He attended Purdue University.

Julian Arthur Arntson (M. '29) civil engineer in the water division of the Department of Public Utilities, at Tacoma, Wash., died on August 31. He was 64. Mr. Arntson had been engaged by the City of Tacoma in various capacities for over 40 years. He assisted in the design of one of the major hydroelectric installations there. A charter member of the Tacoma Section of the Society, he served as secretary-treasurer from 1930–1933. He received his engineering training at the University of Wisconsin.

Raymond Hanson Findley (Assoc. M. '17) since 1927 chief engineer for the Omaha and Council Bluffs Street Railway Co., at Omaha, Nebr., died there on July 28. His age was 67. Upon his graduation from the University of Nebraska in 1908, Mr. Findley entered the employ of the Omaha and Council Bluffs Street Railway Co. He had charge of all the company's construction projects in recent years.

John Leslie Hemmert (Assoc. M. '39) supervising engineer in the materials and research division of the California Division of Highways, at Sacramento, died there on June 28, at the age of 55. Mr. Hemmert had been with the California Division of Highways since 1928—recently in charge of the steel department, where he supervised the inspection of all structural steel for state contracts. Earlier in his career he worked for various water and highway commissions, the University of Idaho, and the Bureau of Public Roads. He received his degrees from the University of Idaho.

Charles Sumner Henning (M. '36) since 1927 a member of the Henning-Payne Construction Co., of Abilene, Tex., died on August 26, at the age of 63. Prior to 1927 he was engineer for El Paso and Hill counties (Texas), division engineer for the Texas Highway Department in Fort Worth, and special engineer for Eastland County, Texas. Mr. Henning was a past-president of the AGC.

(*Continued on page 72*)

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Deceased

(*Continued from page 70*)

John Edward Kirkham (M. '19) research professor emeritus of civil engineering at Oklahoma A. & M. College, died at his home in Mercedes, Tex., on August 7. His age was 80. Professor Kirkham was on the Oklahoma A. & M. staff for many years, retiring in 1944. Earlier he was employed by various consulting engineers, railroads, and steel companies in Kansas and Pennsylvania and served on the faculties of Pennsylvania State College and Iowa State College, where he was acting head of the civil engineering department. He graduated from the University of Missouri.

Walter Joseph Knight (M. '21) structural engineer of St. Louis, Mo., died on July 26. He was 69. In 1915 Mr. Knight organized the firm bearing his name and practiced in St. Louis until the time of his death. He collaborated on the design of many St. Louis landmarks, including the Mart Building. Prior to establishment of his firm he acted as chief engineer for the Gilsonite Construction Co., and was vice-president of the consulting firm of Bergendahl-Knight Co., in Chicago, Ill. He was associate editor of *Reinforced Concrete and Masonry Structures*, and a graduate of Alabama Polytechnic Institute.

Thomas Dotterer Lebby (M. '40) chief of the construction and maintenance department, Tennessee Valley Authority, at Chattanooga, Tenn., died on September 1, at the age of 55. Educated at Massachusetts Institute of Technology and Harvard University, Mr. Lebby was early connected with the Philadelphia Electric Co., the U.S. Navy, and the Bethlehem Shipbuilding Corp. For some time he practiced engineering in Mississippi and Tennessee. In 1935 he became superintendent of construction and maintenance at Wheeler Dam for the TVA, and the next year chief of the construction department at Chattanooga.

Edgar Gleim Maclay (M. '12) for a number of years building manager for the First National Bank, at Houston, Tex., died some time in May 1950, according to word just received at Society Headquarters. He was 70. Upon his graduation from the University of Missouri in 1902, Mr. Maclay entered the employ of E. C. and R. M. Shankland, consulting and designing civil engineers of Chicago, Ill. His later experience included work as engineer and assistant manager in the Concrete Reinforcement Department of the American Steel & Wire Co., and chief engineer for the American Construction Co., at Houston, Tex.

Randolph Rosewell Page (M. '43) engineer in the estimates branch of the General Service Administration, in Washington, D.C., died there on August 9, at the age of 66. From 1910 to 1917 Mr. Page served as assistant city engineer for Jacksonville, Fla. He was then associated with the Chesapeake & Ohio Railway; Marion County, South Carolina; the South Carolina Highway Department; and the Federal Works Agency. During World War II he was senior engineer in charge of construction at the Glynco Lighter-than-Air Naval Base, Brunswick, Ga., and later was with the Bureau of Yards and Docks in Wilmington, N.C., and Norfolk, Va. He was a Virginia Polytechnic Institute graduate.

Dewey James Rierdon (Assoc. M. '36) of Phoenix, Ariz., died on May 7. He was 52. Mr. Rierdon was first employed by the U.S. Bureau of Public Roads, at Portland, Oreg., doing highway location and construction work. In 1924 he joined the U.S. Indian Service, becoming district highway engineer in charge of the district road office in Phoenix, Ariz., in 1935.

Howard Raymond Staley (Assoc. M. '38) construction engineer of the Raw Materials Division of the Atomic Energy Commission, Washington, D.C., died on August 23. He was 51. At the outset of his career Mr. Staley was construction superintendent and partner in the B. S. Staley & Sons Construction Co., at Centerville, Iowa. Joining the staff of the Massachusetts Institute of Technology, his alma mater, in 1935 he became assistant professor of building construction in 1939 and associate professor in 1946. He resigned in January to go with the AEC.

Walter William Stegman (Assoc. M. '44) engineer of Wheeling, W. Va., died there on July 30, at the age of 58. He graduated from Carnegie Institute of Technology. Mr. Stegman began his career with Orion Koller, advancing to the position of chief engineer in 1919. Subsequently he established a consulting engineering office in Wheeling, where he practiced until the time of his death. He was also director of public works and city engineer there, having had charge of many improvements, including the construction of the Chapline Street Bridge.

Earle Lytton Waterman (M. '22) member of the civil engineering department at the State University of Iowa for 32 years, died in Iowa City on July 30. He was 65. Professor Waterman had been head of the department since 1944, but had taught on a part-time basis since 1949 because of ill health. He received a B.S. degree from the University of Vermont in 1907 and held various engineering positions before going to Iowa in 1919. Professor Waterman was active in civic affairs in Iowa City, where he was chairman of the city planner's commission for ten years.

Kendal Aldrich Woodrough (Assoc. M. '29) engineer for the J. R. Worcester Co., at Boston, Mass., died on August 28. His age was 58. Mr. Woodrough served the Worcester Co. as civil engineer for over 20 years. He received his training at Lowell Institute.

NEWS OF ENGINEERS

Stanford P. McCasland, formerly engineer-in-charge of the United Western Investigations of the U.S. Bureau of Reclamation, at Salt Lake City, Utah, is now connected with the consulting firm of Sanderson & Porter, with headquarters in the New York office.

Jean H. Knox, until recently consulting engineer for the Floridagold Citrus Corp., Winter Haven, Fla., has established an engineering office at 1519 Cedar Hill Avenue, Dallas, Tex.

James E. Moreland, of Nashville, Tenn., is now engineer consultant to the International Bank for Reconstruction and Development, with headquarters in Bogota, Colombia, South America.

Stewart E. Reimel, brigadier general, Corps of Engineers, U.S. Army (retired) and secretary of the Committee on International Relations of the Engineers Joint Council, has been named "Chevalier" in the National Order of the Legion of Honor. The distinction is granted him by the French Government "as a token of gratitude for eminent services rendered to the Allied cause during the two world wars and for outstanding contribution to closer cooperation between French and American engineers." Now consultant to the Defense Production Administration, General Reimel is former chief of the New York Ordnance District of the Army.

General Reimel

S. S. Steinberg, dean of the College of Engineering at the University of Maryland, has been reappointed by Governor McKeldin to the State Board or Registration for Professional Engineers and Land Surveyors, for a five-year term. Dean Steinberg has been a member of the board since 1941, and chairman for the past two years.

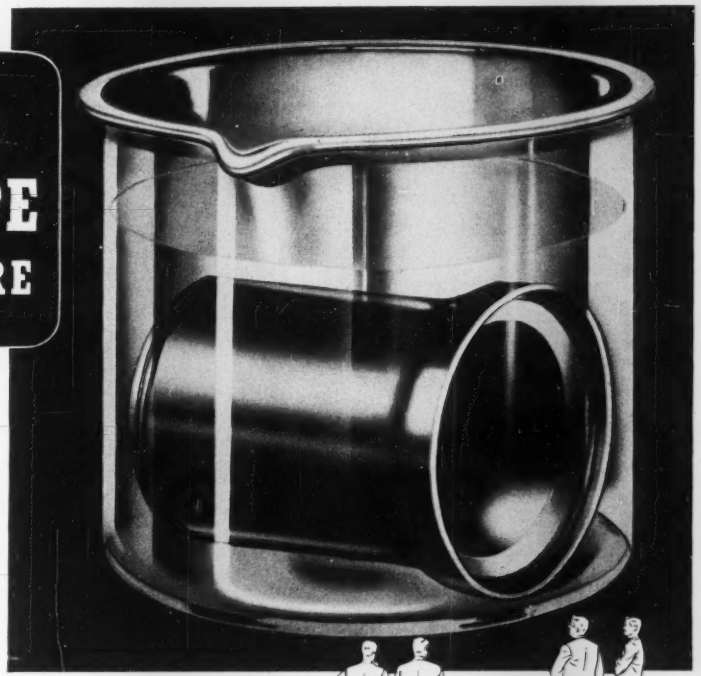
Malcolm Pirnie, national chairman of the executive committee of the Harvard Foundation for Advanced Study and Research, is a member of the newly created Harvard Foundation Council for the year, 1951–1952. Mr. Pirnie is Past-President of ASCE and a New York City consultant.

George J. Nold, Deputy Chief of Engineers, at Washington, D.C., has been appointed chairman of the Board of Engineers for Rivers and Harbors. The seven-man permanent board reviews all reports to Congress on river and harbor, flood control and multiple-purpose projects of the Corps of Engineers, and also compiles reports for the Chief of Engineers.

A. C. Shire announces the opening of offices in the DuPont Circle Building, Washington, D.C., for consulting services on all

(*Continued on page 74*)

SPECIFY CLAY PIPE AND BE SURE



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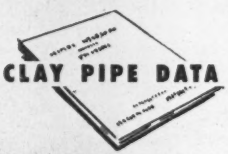

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News of Engineers

(*Continued from page 72*)

phases of building and housing. Formerly Mr. Shire served as chief engineer for the Housing and Home Finance Agency, Housing Technology Branch.

Arvon L. Davies is now assistant to the president of the Chemstrand Corp., at Decatur, Ala. Previously he was with Merritt-Chapman & Scott Corp., New York, in a similar capacity.

E. J. Cleary, executive director and chief engineer of the Ohio River Valley Water Sanitation Commission, at Cincinnati, Ohio, has been nominated for the presidency of the American Public Works Association.

Richard L. Lauderdale, sales engineer for Builders-Providence, Inc., has joined the engineering sales staff of Builders-Pacific, Inc., in Berkeley, Calif.

John C. Park, formerly professor of highway engineering at the University of Arizona, has been named dean of the Engineering College, succeeding **G. M. Butler,** who has retired.

Frank L. Ehasz has moved his structural and civil engineering offices to 730 Fifth Avenue, New York City.

F. W. Wheeler, formerly professor of civil engineering at the University of Virginia, has become affiliated with the firm of Polglaze & Basenberg, at Birmingham, Ala.

Emmert M. Lowry, Jr., research assistant at the Massachusetts Institute of Technology, has accepted a position as engineer-in-charge of the hydraulic laboratory of the S. Morgan Smith Co., in York, Pa.

R. M. Cook has resigned as assistant professor of civil engineering at Northwestern University to become associated with the engineering firm of Hazelet & Erdal, in Chicago, Ill.

William E. Potter, colonel, U.S. Army, and for the past seven months Assistant Chief of Engineers for Special Projects in the Office of the Chief of Engineers, Washington, D.C., has reported for duty in the National War College of that city.

Glenn B. Woodruff has been appointed consulting engineer for the Bechtel Corp., Engineers and Constructors, primarily for consultation and review of the company's civil and structural problems. He will maintain an office at 101 California Street, San Francisco.

Robert C. Boesser, lieutenant ORC, has been recalled to active duty with the Army and is now stationed at Fort Devens, Mass. He is on leave from Edwards, Kelcey & Beck, consulting engineers, of Newark, N.J.

Edwin H. Gaylord is newly elected chairman of the civil engineering division of the American Society for Engineering Education. Other officers of the civil engineering division are **Prof. W. M. Lansford,** of University of Illinois, past-chairman and representative to Council; **Prof. F. W. Stubbs,** of Purdue University, vice-chairman; and **Prof. Arthur J. McNair,** of Cornell University, director and secretary, 1952.

A. D. Engle, a member of the Austin Company's engineering staff since 1920 and its district engineer at Chicago since 1945, has been appointed assistant vice-president for research. Mr. Engle will be responsible for special engineering research work and certain

A. D. Engle

George Miller

foreign assignments, with headquarters at the company's general offices in Cleveland. **George Miller,** coordinating engineer for the Austin Company on Atomic Energy Commission work at Oak Ridge, Tenn., since 1948, succeeds Mr. Engle as Chicago district engineer.

William W. Aultman, for more than 20 years with the Metropolitan Water District of Southern California, resigned on August 1 to accept the position of assistant director of the Department of Water & Sewage of the City of Miami, Fla. Mr. Aultman was water purification engineer for the District for many years, and has been in charge of the operation of its water-softening plant since its completion.

Raymond R. Ribal, former assistant city engineer of Oakland, Calif., has been appointed chief engineer and general manager of the Orange County (California) Sanitation District. In his new capacity he will direct construction of the $8,000,000 sewage program voted by the county two years ago.

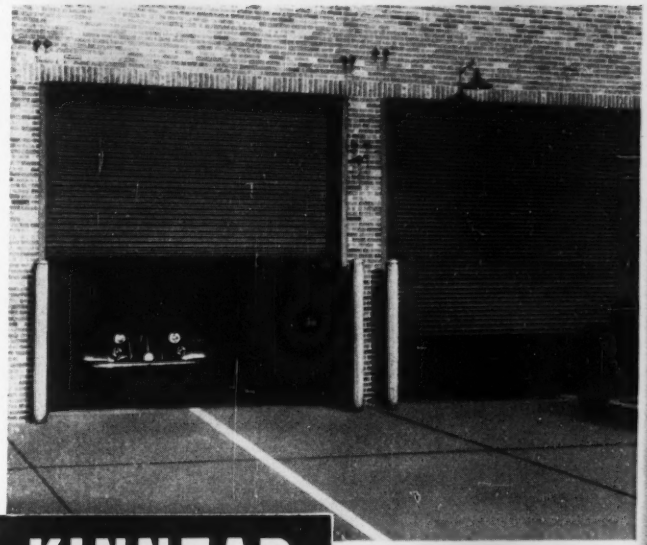
Earle V. Miller has been named to the post of Idaho Highway Engineer. Connected with the Arizona State Highway Department since 1923, Mr. Miller has recently been assistant deputy state highway engineer. During his tenure with the Arizona Highway Department, he has developed principles of vertical and horizontal curve design based on speeds and relocated more than 1,500 miles of highway on a long-range reconstruction plan.

R. P. Westerhoff has been elected vice-president and director in charge of the Engineering Department of Ford, Bacon & Davis, engineers-constructors, of New York, Chicago, Philadelphia and Los Angeles. With the firm for 20 years, Mr. Westerhoff has had charge of the engineering planning, design and construction of large-scale plants in the chemical, metallurgical, natural gas, food processing and fertilizer industries, as well as many steam power plants.

William F. M. Longwell, previously associate professor of civil engineering at Worcester Polytechnic Institute, has joined the Thompson & Lichtner Co., Inc., Engineers, of Brookline, Mass., as principal engineer.

(*Continued on page 76*)

OPEN WIDE



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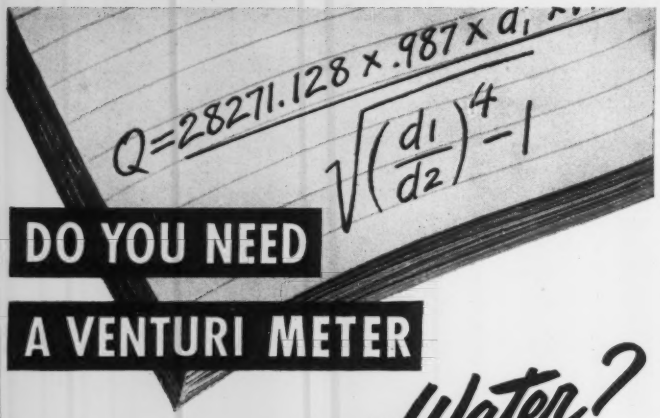

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SIMPLEX

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News of Engineers

(*Continued from page 75*)

Samuel A. Greeley, newly elected Honorary Member of ASCE and sanitary engineering consultant of Chicago, is this year's recipient of the Brown Medal of the Franklin Institute. Mr. Greeley is cited "for his leadership in the profession of sanitary engineering and his many contributions to knowledge in that field which have particularly improved the welfare of urban populations."

Adolph J. Ackerman has returned to the United States from São Paulo, Brazil, where he has been for several years as vice-president of "Cobast" on construction of the Paraiba-Pirai Hydroelectric Diversion Project, which he describes in an article elsewhere in this issue. While in Brazil Mr. Ackerman serves as president of the recently formed Brazil Section of ASCE. He will establish an engineering practice in Madison, Wis.

William J. Bond has been appointed chief field engineer and supervisor for Ebasco Services, Inc., on the Joppa Steam Plant on the Ohio River.

William J. McDonald, of Chattanooga, Tenn., has been called to active duty as a lieutenant in the Civil Engineer Corps of the U.S. Naval Reserve. He is stationed with the Mobile Construction Battalion at Davisville, R.I.

Felix A. Wallace is on leave of absence from his position as head of the civil engineering department at the College of the Pacific at Stockton, Calif., to do graduate work for his Ph.D. degree at Carnegie Institute of Technology.

Frank Reynolds, former Sacramento consultant, has been appointed principal highway engineer for the California State Division of Highways, with headquarters in Sacramento. He will head a new section that will have charge of the preparation of special legislative and financial reports.

Franklyn C. Rogers, on leave for the past year from the post of professor of civil engineering at Rutgers University, has returned from India where he represented the Harza Engineering Co., of Chicago, as resident engineer on the Maithon project of the Damodar Valley Corp. He also handled the post of director of engineering for the Damodar Valley Corp. Professor Rogers has resumed his duties at Rutgers University as director of the Joint Highway Research Project.

Marvin O. Kruse, for the past 16 years associated with the Stanley Engineering Co., of Muscatine, Iowa, has taken over the consulting practice of Leon L. Schoel & Associates, at Spencer, Iowa, and will continue the practice under the firm name of Kruse Engineering Services.

Howard Hansen has been appointed research engineer in the civil engineering department of Illinois Institute of Technology. Since 1949 Mr. Hansen has been head of the structures research department, Naval Civil Engineering Research Laboratory, Port Hueneme, Calif. He has also served on the faculties of Tulane, Texas A. & M., and the University of Florida.

New Publications

University Research. Engineering research policies and activities of 91 colleges and universities holding membership in the Engineering College Research Council of the American Society for Engineering Education are outlined in the *Review of Current Research and Directory of Member Institutions*. In addition to complete project titles, this guide to current research gives the names of responsible administrative officers, a digest of policies, personnel engaged in research activities, and annual expenditures at each institution. Copies, priced at $2.25 each, may be obtained from the Secretary of the Engineering College Research Council, Room 7-204, 77 Massachusetts Avenue, Cambridge 39, Mass.

Water-Resources. The Geological Survey announces that 14 reports on water resources in various sections of the country are being released in open files. Copies are available for consultation in the General Services Building, Washington 25, D.C., and in other places listed. Further information may be obtained by writing to the U.S. Geological Survey, Washington, D.C., for the *Announcement of Water-Resources Reports Released for Public Inspection*.

Mosquito Abatement. Availability of the twentieth annual report of the Alameda County Mosquito Abatement District is announced. A general history of the organization of the district is given, as well as a report of progress for 1950. Inquiries should be addressed to the Alameda County Mosquito Abatement District, 1-A Court House, Oakland 7, Calif.

Highway Research. The results of studies of Ohio highways, roads, and streets are summarized in a recent study made by the Automotive Safety Foundation for the Ohio Program Commission and the Highway Safety Commission. This work, entitled *An Engineering Study of Ohio's Highways, Roads, and Streets*, embraces only the engineering and administrative phases of Ohio's highway problems: a fiscal study is being treated in a separate study. For further information write to Ohio Program Commission 40 S. Third St., Columbus 15, Ohio.

Traffic Planning. Studies of the mathematical relationship between vehicle turns and crossing pedestrians are presented by the ENO Foundation in *Turn Controls in Urban Traffic*. They were designed to aid traffic officials in developing factual warrants for establishing turn prohibitions and controls. For further information write to The ENO Foundation for Highway Traffic Control, Saugatuck, Conn.

Airport Research. Issuance of several recent publications of the Civil Aeronautics Administration is announced. These are Technical Development Report No. 127, entitled *The Measurement of Soil Moisture and Density by Neutron and Gamma-Ray Scattering* by D. J. Belcher, T. R. Cuykendall, and H. S. Sack; No. 131, covering *Use of the Rational Formula in Airport Drainage* by Raymond C. Herner, R. C. Mainfort, and R. L. Pharr; and No. 136, entitled *A Summary Report on Soil Stabilization by the Use of Chemical Admixtures* by R. C. Mainfort. Inquiries should be addressed to the Civil Aeronautics Administration, Technical Development and Evaluation Center, Indianapolis, Ind.

City Planning. An illustrated brochure, written by Robert Moses, Commissioner of Parks, for the Triborough Bridge Authority and the State of New York, discusses Ward's Island Park, Ward's Island Pedestrian Bridge, the Hellgate waterfront, and other recent New York City improvements. Address inquiries to the Triborough Bridge and Tunnel Authority or Department of Parks, New York, N.Y.

Highway Research. Four papers by R. F. Hibbert, Evan P. Bone, D. M. Finch, and B. W. Poccock and C. C. Rhodes, sponsored by the Committee on Night Visibility of the Highway Research Board are contained in Bulletin No. 34, entitled *Reflectors and Night Visibility*. Copies of this bulletin may be purchased for 90 cents each from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

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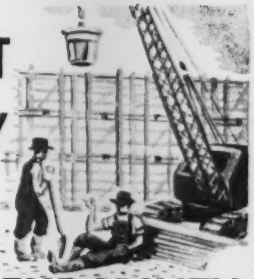

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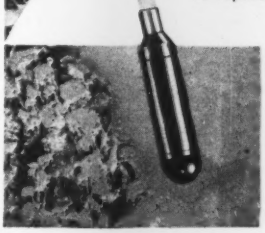

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Positions Announced

District Public Works Office, Third Naval District. Opportunity for Fire Prevention Engineer (starting salary, $5,400 a year) in the District Public Works Office of the Third Naval District with headquarters in New York City is available. To qualify, applicant must have an engineering degree from an accredited college or university or the equivalent in technical experience, and at least three years of progressive field engineering experience, particularly fire protection inspections. Inquiries should be addressed to the District Public Works Officer, Third Naval District, Room 1505, 90 Church Street, New York 7, N.Y.

Veterans Administration, Washington, D.C. Several civil engineering vacancies are available in the Central Office of the Veterans Administration, Washington, D.C. These include Grade GS-5, at $3,100–$3,850 per annum; GS-7, at $3,825–$4,575 per annum; Grade GS-9, at $4,600–$5,350 per annum; and GS-11, at $5,400–$6,400 per annum. Further information may be secured from Mr. Jerome J. Deutsch, Personnel Division, Veterans Administration, Brooklyn Regional Office, 35 Ryerson Street, Brooklyn 5, N.Y.

The Engineer Center, Fort Belvoir, Va. Announcement of engineering vacancies in the Engineer Center at Fort Belvoir, Va., is made. Positions include engineering draftsman, Grade GS-5, at $3,100 per year; bridge engineer, GS-11, at $5,400 per year; civil engineers, GS-5 through GS-9, at $3,100–$4,600 per year; photogrammetric engineer, GS-9, at $4,600 per year; sanitary engineer, GS-7 through GS-9, at $3,825–$4,600 per year; structural research engineer, GS-9, at $4,600 per year; and surveying and cartographic engineer, GS-5 through GS-9, at $3,100–$4,600 per year. Standard Form 57 may be obtained from any Civil Service Commission or Department of the Army Civilian Personnel office and should be mailed to the Civilian Personnel Branch, Employee Utilization Section, Building 211, Room 200 A, the Engineer Center, Fort Belvoir, Va.

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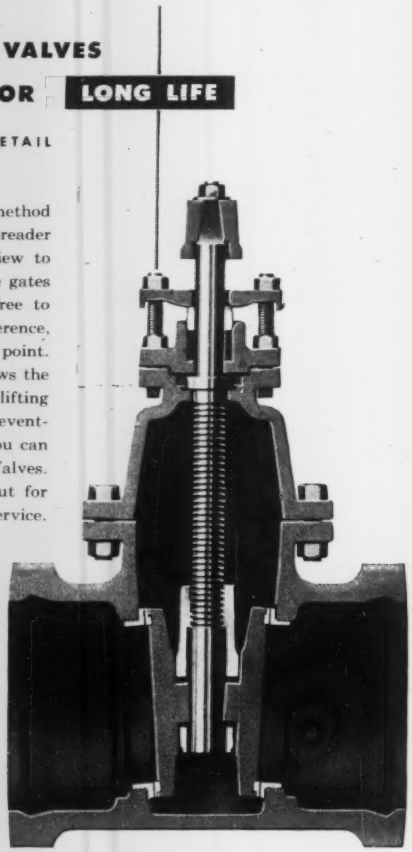

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Meetings and Conferences

American Concrete Institute. Headquarters for the regional meeting of the American Concrete Institute will be the Sheraton Hotel, in St. Louis, Mo., October 30 and 31. For further information contact Carl Chappell, Regional Meeting Publicity Chairman, c/o Portland Cement Association, 915 Olive Street, St Louis 1, Mo.

American Institute of Electrical Engineers. The fall meeting of the American Institute of Electrical Engineers is scheduled for Cleveland, Ohio, October 22–26.

American Public Health Association. "Our Stake in World Health" will be discussed during the 79th annual meeting of the American Public Health Association at the Civic Auditorium and the Palace and Whitcomb hotels in San Francisco, Calif., October 29 to November 2.

American Society of Planning Officials. Planning in the 1950's is the theme of the National Planning Conference, which is being conducted by the American Society of Planning Officials, at the William Penn Hotel, Pittsburgh, Pa., October 14–17.

American Standards Association. The role that part standards are playing in national defense will be discussed at the second annual meeting of the American Standards Association at the Waldorf-Astoria Hotel, in New York City, October 22–24.

Building Research Advisory Board. Dates for the Conference on Atomic Installations in Building, originally scheduled for October, have been changed to November 27 and 28, with an evening meeting scheduled for the 27th. Sponsors, in addition to the BRAB, are American Institute of Architects and the Atomic Energy Commission. The sessions will be held in the main auditorium of the National Academy of Sciences, Washington, D.C.

National Council of State Boards of Engineering Examiners. Headquarters for the 30th annual convention of the National Council of State Boards of Engineering Examiners will be the Hotel Statler, in Boston, Mass., October 21–24.

Engineers Council for Professional Development. Headquarters for the annual meeting of the Engineers Council for Professional Development will be the Hotel Statler, in Boston, Mass., October 19 and 20.

First National Congress of Civil Engineers of Mexico. The Colegio de Ingenieros Civiles de Mexico will hold the First National Congress of Civil Engineers of Mexico in Monterrey, October 29–November 3.

Florida Sewage and Industrial Wastes Association and the American Water Works Association. A joint fall meeting of the Florida Sewage and Industrial Wastes Association and the Florida section of the American Water Works Association will take place at the Princess Issena Hotel, at Daytona Beach, Fla., October 28–31.

Second Conference on Coastal Engineering. Sponsored by the Southwest Research Institute with the cooperation of the Council on Wave Research of the University of California, the Texas A. & M. Research Foundation, Rice Institute, University of Houston, and the Houston Branch of the Texas Section of the American Society of Civil Engineers, the Second Conference on Coastal Engineering will be held at the Rice Hotel, in Houston, on November 7–10. Inquiries should be addressed to Charles E. Balleisen, Conference Secretary, c/o Southwest Research Institute, 8500 Culebra Road, San Antonio 6, Tex.

Seventh National Conference on Industrial Hydraulics. Latest developments in the industrial hydraulics field will be presented at the Seventh National Conference on Industrial Hydraulics—under the sponsorship of the Graduate School and the Armour Research Foundation of the Illinois Institute of Technology—at the Sherman Hotel, in Chicago, Ill., November 8 and 9.

Virginia Highway Conference. The annual three-day Virginia Highway Conference, sponsored jointly by the engineering department of the Virginia Military Institute and the Virginia Department of Highways, will open in Lexington, Va., on October 15.

World Metallurgical Congress and National Metals Exposition. Sponsored by the American Society for Metals, the World Metallurgical Congress will be held concurrently with the National Metals Exposition in Detroit, Mich., October 14–19. A seminar on interfaces will be conducted by ASM on October 13 and 14.

Applications for Admission to ASCE, August 18—September 11

Applying for Member

OLE HANS BENTZEN, Uganda, East Africa.
JOHN FRANKLIN CHANDLER, Norfolk, Va.
BERNARD CROCKER, JR., Raleigh, N.C.
JESSE PHILLIPS DUNNAGAN, San Francisco, Calif.
LEON THEODORE ELIEL, Pasadena, Calif.
JAMES HENRY FOLBY, Winterport, Maine.
ROBERT GORDON HART, Milwaukee, Wis.
CHARLES GEORGE HAWBS, Uganda, B. E. Africa.
CHARLES GEORGE HOLLE, New Orleans, La.
WALTER HENRY LEE, Kansas City, Mo.
HENRY JOHN MANGER, St. Paul, Minn.
VASHRAJ GOVINDBHAI PATEL, Bombay, India.
NORMAN LIND PEDERSEN, Beverly Hills, Calif.
LOUIE ARTHUR REDDING, Montgomery, Ala.
PHILIP NEICE ROYAL, Seattle, Wash.
MARIO SAVELLI, Rio de Janeiro, Brazil.
PAUL DORWARD SCHLENKER, Canton, Ohio.
JOHN MEREDITH TRISSAL, Chicago, Ill.
WILLIAM WELLS VANCE, Washington, D.C.
SRI RAM VASUDEV, New Delhi, India.
FRED NIXON WISEHART, Louisville, Ky.
FRANK WOLFSHEIMER, Washington, D.C.

Applying for Associate Member

LAWRENCE HARRY ARCHER, Ada, Ohio.
HARRY BIEBER, Los Angeles, Calif.
CARL HUSTON CLAWSON, Rock Hill, S.C.
CHARLES HOYT ELLIS, Homewood, Ala.
GUSTAV MAYER, Cleveland, Ohio.
WADE LAMONT MENOHER, Boulder, Colo.
HERSCHEL BYRON MILLER, Houston, Tex.
RICHARD TUCKER PAGE, Lawrence, Kans.
EDWARD WILLIAM ROTHFUSS, JR., Salt Lake City Utah.
NIELS THORSEN, New York, N.Y.
SAMUEL WESTON, New York, N.Y.

Applying for Junior Member

JOHN B. ABELL, Lynwood, Calif.
JOHN RALPH BURTON, Sydney, Australia.
ARTHUR HAROLD COLBY, Warrington, Fla.
BILLY JOE HAMILTON, Tulsa, Okla.
WILLIAM BATES JAMISON, Annapolis, Md.
ROBERT DONOVAN KERSTEN, Tulsa, Okla.
DESMOND O'RIORDAN, New York, N.Y.
DAVID EDWARD PETTIGREW, Miami, Fla.
RAY EDWARD STREIFF, Milwaukee, Wis.
FERDINAND JAMEEL TAWEEL, Springfield, Ill.
JOHN EDWARD TURNBULL, Tulsa, Okla.
ENRIQUE VARGAS-RAMIREZ, Gainesville, Fla.
GEORGE ITTY VURGESE, Kilmarnock, Scotland.
JAMES HAMPTON WISEMAN, JR., Fayetteville, Ark.
RONALD WILLIAM WOODHEAD, Lawson, N.S.W., Australia.

[Applicants for Junior membership from ASCE Student Chapters are not listed.]

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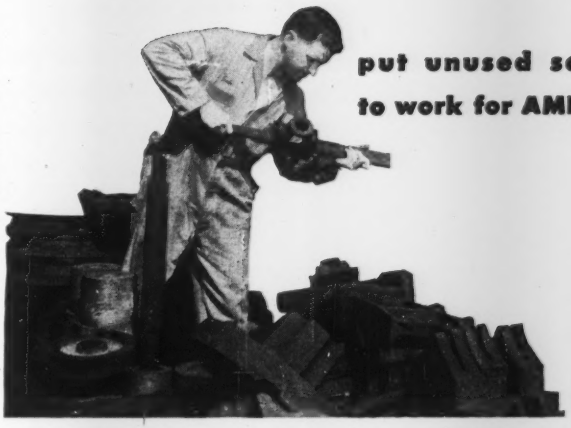

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RECENT BOOKS

American Society for Testing Materials, Proceedings, Volume 50, 1950

This annual ASTM publication includes all reports and papers offered to and accepted by the society's Committee on Papers and Publications. Both the committee reports and the technical papers are arranged in broadly classified groups. The subject and author indexes cover not only the contents of the Proceedings but also the articles published in the ASTM Bulletin or as Special Technical Publications. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1951. 1490 pages, $12.)

Der Rammpfahl

Of interest to the engineer concerned with the design and operation of piles, this book (by W. Schenck) considers both the practical and theoretical aspects of pile-driving operations. Results of experiments with commercial piles under natural conditions are discussed. Tables are included to aid in calculations needed both in design and practical operation. (Verlag von Wilhelm Ernst & Sohn, Berlin, 1951, 11 D.M.)

Design of Prismatic Structures

This book, by A. J. Ashdown, describes a method of designing sloping reinforced concrete slabs for pitched roofs, the bottoms of bunkers, and other purposes. In addition to theoretical considerations, practical design problems are solved by various methods, among which are the relaxation, column analogy, moment-balance, and an American method of combining bending and direct thrust. (Concrete Publications, Ltd., 14 Dartmouth Street, London, S.W.1, England, 1951. 65 pages, $1.85.)

Deutscher Ausschuss für Stahlbeton, Heft 102.

In this report A. Eckhardt and W. Kronsbein describe in detail the developments and results of experiments on the behavior of concrete and cement in seawater. Numerous tables illustrate the behavior of the various types of cements and the effects of their constituents. (Wilhelm Ernst & Son, Berlin, 1950. 54 pages, 6.50 *D.M.*)

Dimensional Analysis and Theory of Models

Devoted to the principles of dimensional analysis this book, by H. L. Langhear, treats the general form of equations that describe natural phenomena. The first four chapters deal with basic principles and develop them mathematically. Chapter 5 covers the theories of similarity and model testing. The remaining five chapters treat specific applications of dimensional analysis. A knowledge of the principles of physics and engineering usually presented in the first three years of an engineering curriculum is assumed. (John Wiley & Sons, New York; Chapman & Hall, London, 1951. 166 pages, $4.)

Einflüsse auf Beton und Stahlbeton

Written in the form of a dictionary, *Einflüsse auf Beton und Stahlbeton*, by A. Kleinlogel with the assistance of K. Walz and H. Vierheller, discusses the various factors which affect the properties and behavior of concrete and reinforced concrete. Extensive references to the literature are given as footnotes. The fifth edition is expanded to include the developments that have taken place in the field since the 1940 edition. (Verlag Wilhelm Ernst & Sohn, Berlin, 1950. 339 pages, paper 25 *D. M.*; bound, 28 *D. M.*)

Mathematical Solution of Engineering Problems

Particularly designed and written for the use of technicians who are familiar with basic mathematics but require guidance in effective practical application, this book, by J. Jennings, contains special chapters on the construction of the nomogram, on statistical methods, and on dimensional analysis. The importance and utility of approximate methods of solution have been emphasized and practical illustrations given. (E. and F. N. Spon, Ltd., 22 Henrietta Street, London, W.C.2, 1951. 208 pages, 25*s.*)

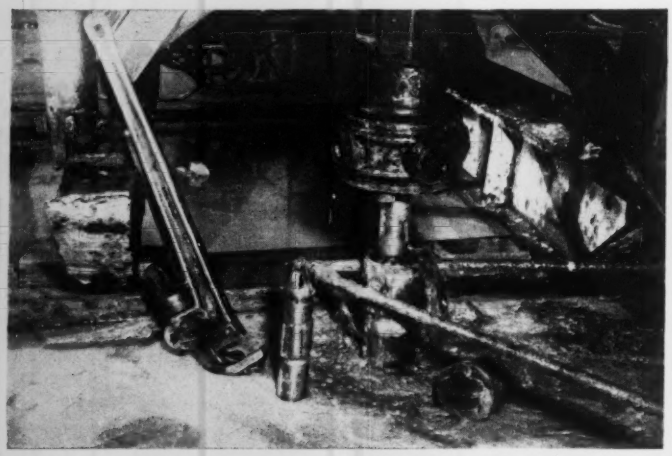
Nomographic Charts

Ninety-two nomographs are given, by C. A. Kulmann, for solving a variety of functional and general problems in such fields as hydraulics, mechanics, thermodynamics, and electrical engineering. Each chart occupies a full page and is accompanied by an explanation to aid in its use. The accuracy of the charts lies between ordinary slide-rule computation and exact numerical computation. Alignment, intersection and combinations of intersection and alignment nomographs are the types given. (McGraw-Hill Book Co., New York, Toronto, London, 1951. 244 pages, $6.50.)

Principles of Geology

Summarizing present geological knowledge, this book, by J. Gilluly, A. C. Waters and A. O. Woodford, concentrates on the analysis of processes that are at work upon and within the earth. Among the branches of physical geology covered are mineralogy, petrology, geodesy, structural geology, and geomorphology. Brief treatments are given of historical and economic geology. The appendix contains sections dealing with techniques of topographic mapping and the identification of minerals and rocks. (W. H. Freeman & Co., 549 Market Street, San Francisco 5, Calif., 1951. 631 pages, $5.75.)

(Continued on page 86)



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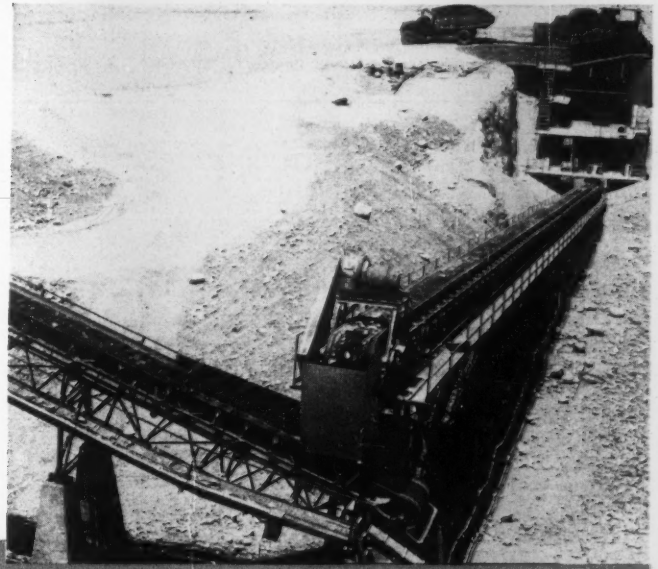

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BUILDING MAINTENANCE ENGINEER, under 50, mechanical engineering graduate, with at least 5 years' steam power, heating and general building maintenance experience, to supervise power plant operations, maintenance, cost records and plan improvements. Salary $8000–$9000 a year. Location Brooklyn, N.Y. Y-5534.

SALES ENGINEERS. (*a*) District Sales Manager, civil engineering degree, for large manufacturing concern in construction materials. Must have had experience in contacting engineers and contractors and be a resident of the South. Excellent opportunity. Salary open. Location, Georgia. (*b*) Sales Engineers, 24–40, graduate civil engineers, with some sales experience, to represent above company. Territories, Atlanta, Ga., and Decatur, Ala., and their vicinities. Prefer applicants from the South. Salary open. Y-5566.

STRUCTURAL ENGINEERS, 26–50, degree in civil engineering or equivalent in experience, who are capable of assuming a great deal of responsibility in design and drafting work with a moderate amount of supervision. Must be willing to do primarily board work. Salary open. Location, Alabama. Y-5697.

JOB ENGINEER, civil, who has had considerable experience on heavy construction for project which will include piers, power house, railroad, etc. Possibility of taking family at later date. Salary, $9,600–$10,800 a year. Location, Chile at sea level. Y-5755.

CONSTRUCTION SUPERINTENDENTS, not over 50, civil engineering graduates, with at least 15 years' construction experience on hospitals, and other large projects. Positions located within a 500-mile radius of New York City; good living conditions. Salary, $10,400 a year. Headquarters, New York, N.Y. Y-5780.

PLANT ENGINEER, civil graduate, 40–50, with 15 years' maintenance and construction experience to take charge of new plant construction and alterations, power and equipment maintenance for textile mills. Salary, $8,000–$10,000 a year. Location, Pennsylvania. Y-5847.

ENGINEERS. (*a*) Civil Engineer, 35–50, with field and design experience in water distribution and sewerage systems, to take charge of municipal project for American consulting firm. Salary, $9,600–$12,000 a year. (*b*) Assistant Civil Engineer, 26–35, with field or design experience in water works and sewage field. Salary, $7,200–$9,600 a year, plus quarters and subsistence. Location, West Africa. Y-5851.

RESEARCH ENGINEER, about 40–45, civil, with M.S. or Ph.D. and at least 10 years' supervisory research experience in the field of structures and materials, including development of equipment, to take charge of 50 engineers and scientists on government project. Salary, $10,000 a year. Location, California. Y-5877.

ENGINEERS. (*a*) Field Engineers to report to the chief field engineer and assist in all phases of oil refinery construction work. (*b*) Engineer coordinator to coordinate all engineering matters between home office and field office, and be responsible to the chief field engineer to see that all drawings are coordinated for field clearances, instrumentation, electrical layout, etc. Salary open. Location, Brazil. Y-5911.

ASSISTANT PROFESSOR, 30–45, M.S. degree in civil engineering, with recent teaching experience and research or professional practice with specialization in surveying and highway or railroad design and construction. Experience or familiarity with cooperative plan of engineering education required. Registered professional engineer preferred. Preferably an author of technical books or papers with emphasis on instruction and research. Salary open. Location, Ohio. Y-5925.

RESEARCH ASSISTANT OR ASSOCIATE PROFESSOR, Ph.D. in mechanics, to teach advanced fluid mechanics, tensor analysis and carry on research in experiment station. Salary up to $4,800 a year. Starting date September or January. Location, Middle Atlantic States. Y-5929.

HIGHWAY ENGINEERS for layout and design of steel and reinforced concrete structures, such as bridges, overpasses, underpasses, etc., for highway relocation design work. Location, Rhode Island. Y-5934.

DEPARTMENT HEAD of civil engineering, 35–50, master's or doctor's degree with recent teaching experience and research or professional practice with specialization in hydraulic and sanitary engineering. Experience with cooperative plan of engineering education required. Registered Professional Engineer or eligible for registration. Location, Ohio. Y-5956.

(Continued on page 86)

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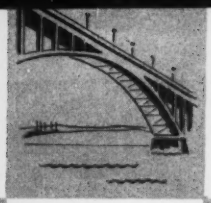

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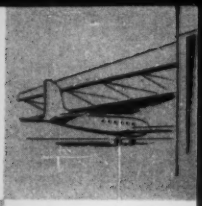

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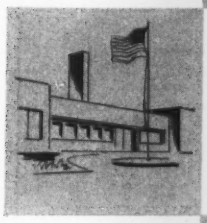

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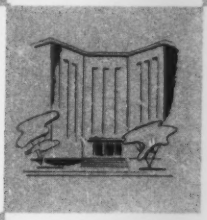

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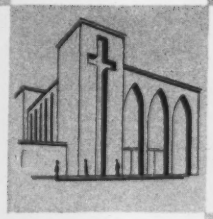

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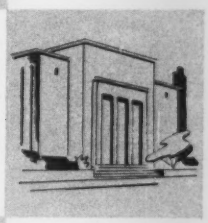

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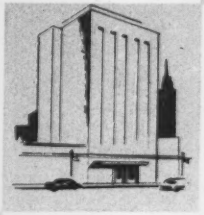

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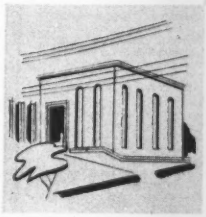

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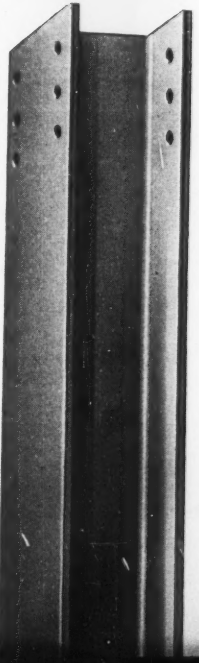

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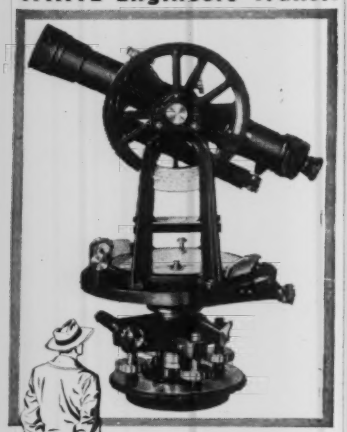

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Positions Available

(*Continued from page 82*)

CIVIL ENGINEER, graduate, with at least 3 years' experience in training or teaching military or civilian personnel covering operation and maintenance of water, sewage, heating, and electrical facilities, to plan courses, etc., for training engineer specialists in various phases of engineering. Appointment for 2 years. Salary, $5,400 a year; living quarters provided. Location, Europe. Y-5959.

CIVIL OR STRUCTURAL ENGINEER experienced in design and detailing of simple steel structures, preparation of job cost estimates and plant supervision. Location, Alabama. Y-5984.

CIVIL OR MINING ENGINEER, 30–40, graduate, with some experience in road building and construction for field work. Knowledge of Spanish essential. Location, Caribbean area. Y-6060.

DEVELOPMENT ENGINEER, civil, about 25. Experienced in highway or runway pavement testing. Knowledge of concrete testing helpful. Duties: Testing and planning; measuring strains and deflections, data and design analysis; and report writing. Salary open. Location, northern Chicago suburb. R-8083.

FIELD ENGINEER, C.E., to 40. Will consider recent graduates. Knowledge of surveying. Duties: Field and/or office work, some drafting, all types of public works. Company will help on fee. Salary $3,600–$5,400 a year. Some travelling. Location, Middlewest. R-8126.

ASSISTANT PROFESSOR, M.S. in C.E. desirable; 35–45. Knowledge of highway engineering for teaching general civil engineering subjects. Salary, $5,000 for 9 months. Location, Michigan. T-8151.

PROCESS ENGINEER with at least 2 years' technical education and 5 years' experience in manufacturing industries, preferably sheet metal fabrication on small and medium parts. Must know design and shop operations. Will do process engineering for manufacture of vending machines. Salary, to $5,200 a year. Location, Chicago, Ill. R-8163.

CIVIL ENGINEER, graduate, 20–40; prefer a man with minimum of 5 years' design experience but will consider recent graduate ranking in upper third of class. Should have knowledge of structural or sanitary engineering. Will design sanitary engineering systems and plants, specification writing, supervision of construction negotiations with clients and contractors for a firm of consulting civil engineers. Salary, $3600–$6,000 a year. Location, Illinois. T-8196.

Recent Books

(*Continued from page 80*)

Route Surveys

This is a revised edition of a pocket book for the survey, design and construction of railways, highways, tramways, beltways, canals, flumes, levees, pipelines, transmission lines, and other route constructions. Written by H. Rubey, it begins with the reconnaissance, proceeds through a detailed discussion of location, curve layout, excavation and embankment, etc., with emphasis on practical procedures. Nearly 300 pages are devoted to data tables for quick reference in the field. (Macmillan Co., New York, N.Y., 282 pages, $5.25.)

Strength of Materials

Based on the previous *Strength of Materials* published jointly with the late Prof. N. C. Riggs, this book, by M. M. Frocht, serves as a text for a first course dealing primarily with basic types of materials failure and their prevention. An unusual feature is the new approach to the subject via statically determinate problems, coupled with the emphasis on the significance of the stresses. Problems are chosen for their technical relevance, and answers to many are supplied at the end of the book. (Ronald Press Co., New York, N.Y., 1951, $5.50.)

(The) Water and the Power, Development of the Five Great Rivers of the West

In this volume A. N. Williams indicates the major trends in the development of the five major Western rivers—the Colorado, Sacramento and San Joaquin, Rio Grande, Missouri, and Columbia—and effects of the development of these rivers on the land and the people. A summation of the over-all problem of water supplies, including the question of public vs. private power is also given, as well as a bibliography. (Duell, Sloan & Pearce, New York, N.Y., 1951, 378 pages, $4.50.)

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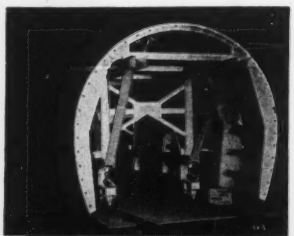

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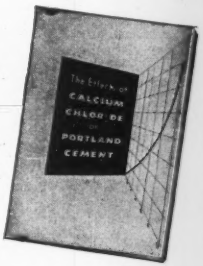

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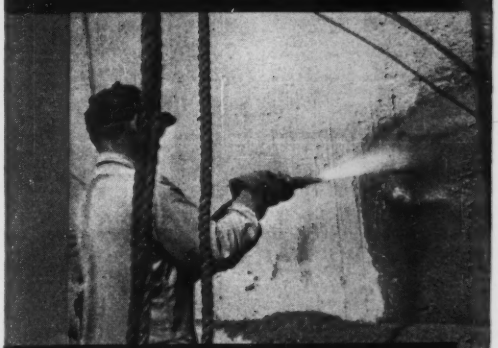

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2 AIR-ENTRAINED CONCRETE

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3 ALLOYS

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American Paulin System—This booklet, available without charge to all civil engineers, is published in the interests of greater efficiency and economy of time and labor in the making of preliminary surveys under all conditions. The observer and author of this work, Raymond A. Hill, M. ASCE, explains in detail the practical use of the Paulin System Altimeter in connection with all branches of preliminary field surveying. Geologists, scientists, topographers, surveyors and educators will find this book of interest and technical value.

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7 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations" catalog B-2 explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

8 BREAK-RESISTANT MASONRY BLADES

Clipper Mfg. Co.—Circular No. 147 gives full information on a blade that is virtually unbreakable. This blade makes possible intricate cutting or grooving with hand power or masonry saws.

9 BUSINESS & TECHNICAL GUIDE

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10 CAST IRON PIPE

Cast Iron Pipe Research Assoc.—A brochure, revised in 1950, gives general specifications, weights and dimensions of standardized mechanical joint cast iron pipe, fittings and accessories for water and gas. Tables show weights and dimensions for pipe centrifugally cast in metal and sand-lined molds and pitcast pipe.

11 CAST IRON PIPE CALCULATOR

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12 CHEM-O-FEEDERS

Proportioneers, Inc.—Bulletin describes application of chem-o-feeders for chlorine dioxide, hypochlorite, and chemical feeding to municipal and private water supplies, sewerage treatment, and swimming pools. Exclusive "See-Thru" reagent heads permitting visible inspection of all moving parts in contact with chemical solution, corrosion resistance, and ability to operate under high pressure are some of the advantages discussed.

13 CONCRETE AIRPORT PAVEMENT

Portland Cement Assoc.—The 46-page booklet is a manual of new design procedures for runways, aprons and taxiways made necessary by heavier wheel loads and multiple wheel landing gears. It contains simplified design charts for determining slab thickness under different conditions of service, jointing practices, use of reinforcing steel, subgrade preparation and construction procedures for concrete resurfacing.

14 CONCRETE FACTS

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15 CONCRETE FORM-TIES

Richmond Screw Anchor Co., Inc.—Comprised of 8 sections devoted to the various styles, types and sizes of form-tying devices and other accessories for concrete construction, the new catalog is an extremely informative, fact packed manual which shows by charts, pictures and word descriptions the proper selection and use of each of the items in the Richmond line. Also, the section on screed supports has been revised and brought up to date as of October 1950. The catalog covers snap-tys, tyscrus, hanging systems, screw anchors and bolts, inserts and other devices.

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There are 157 Digest items on pages numbered 88 to 106. Read all items for the literature of interest to you. It is requested that students and educators write direct to manufacturers.

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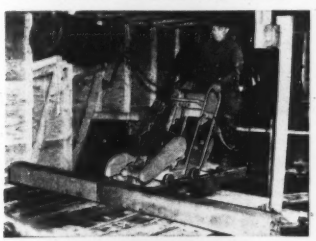
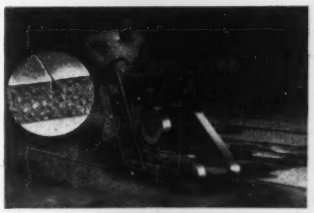
PATCHES—TRENCHES SAWED FOR FLOOR—STREET REPAIR — Saw concrete floors, walks or streets! Saw narrow slit trenches 1" wide for conduit or any width for utility lines. Eliminate jackhammer fractures beyond the straight, smooth sawed lines.—**Write Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**

FLOORS, DRIVES, RUNWAYS EASILY CUT FOR REPAIRS—Rail tunnels, rail and pipe trenches, air lines and machinery bases were cut in dense concrete with a Model C-130 Clipper Concrete Saw and CDS-20 Diamond Blade at the rate of 5' per minute—3" deep. Tremendous savings were claimed by the contractor in removal and replacement.—**Write Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**



TRACK SAW NOW CUTS LARGEST STONE, TRANSITE, TERRA COTTA — By placing C-15 Clipper Concrete Saw on tracks, a Cleveland contractor cut limestone veneer units from 15'x7"x15" quarry lengths. In addition to large, bulky shapes this model is efficient and dustless for inside patch and trench work.—**Write Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**



CONTRACTION JOINTS NOW SAWED—Floors, walks, drives and runways now poured continuously (reduces bulkheading!) Then joints are sawed to eliminate hand forming and costly spalling.—**Clipper Mfg. Co., 2804 W. Warwick, Kansas City 8, Mo.**

STUDIES OF SAWED JOINTS PROVE VIRTUAL ELIMINATION OF SPALLING — Highway transverse joints sawed 2" deep are devoid of spalling after 1½ years in contrast to heavy spalling in a few weeks on formed joints, according to State tests.

Typical spalling after few weeks heavy traffic.

Sawed joints on same highway after 1½ years.

It's Done Easier, Faster, More Economical when you SAW BEFORE BREAKING with CLIPPER CONCRETE SAWS

CONCRETE EVIDENCE

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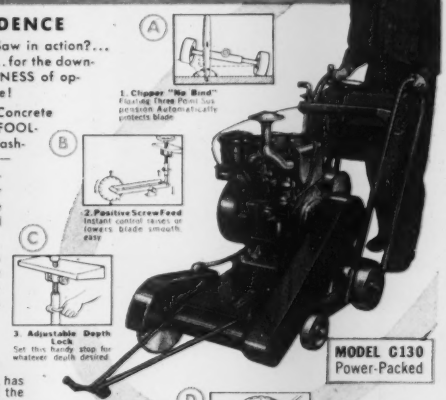
You'll recognize that Clipper Concrete Saws are designed for SIMPLE, FOOL-PROOF DUSTLESS performance. Dashboard controls—perfect balance—floating three point blade suspension* — and "job-rated" power plants...all combined for concrete and asphalt cutting far beyond anyones expectations.

*A pivoting front axle keeps the blade straight in the cut even on rough surfaces—stops binding — stops excessive blade costs.


A
1. Clipper "No Bind" Floating Three Point Suspension Automatically protects blade
B
2. Positive Screw Feed Instant control raises or lowers blade smooth easy
C
3. Adjustable Depth Lock Set this handy stop for whatever depth desired
D
4. Patented Spray Control Its value is measured in increased Blade Life
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16 CONCRETE PIPE

Lock Joint Pipe Co.—A pamphlet describes all past installations of Lock Joint pressure pipe and is illustrated with cross-section cuts of joints and pipe design. Another illustrated pamphlet describes the manufacture and technical design of prestressed concrete cylinder pipe.

17 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipelines, methods of irrigating with concrete pipelines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

18 CONCRETE PIPE HANDBOOK

American Concrete Pipe Assoc.—A handbook contains 384 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill, is presented along with examples and tables. Useful hydraulic data and information on jacking pipe lines is given. A thorough, comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains A.S.T.M. and AASHO specifications. Price $4.00.

N. B. There is a charge for this book. Make checks payable to The American Concrete Pipe Association.

The coupon is not good after the deadline. Return it today.

19 CONCRETE SAWS

Clipper Manufacturing Co.—Circular No. 1-C gives solution to concrete cutting of all types; patches, utility trenches, contraction joints, building floors, walks, drives and even curbs and large concrete pipe.

20 CONTROLLERS AND LAYOUTS

Simplex Valve & Meter Company—Bulletin 250 gives dimensional data on horizontal and vertical type controllers and clearance layouts for these units when using different type close-off arrangements. Type "S" rate controller for use in effluent lines from rapid sand type filters. This bulletin is of essential interest to the filter plant designing engineer.

21 CRAWLER TRACTOR

Allis-Chalmers Mfg. Co.—A 24-page well illustrated catalog, No. MS-427-516, shows the many features of the HD-5 crawler tractor and the almost unlimited chores it will handle with matchless performance.

22 CRAWLER TRACTOR

Allis-Chalmers Mfg. Co.—The HD-5G performs innumerable tasks as pictured in the first pages of this catalog. Hydraulic control, size, ease of handling, and method of construction are a few of the many subjects covered in the 16-page book.

23 CRUSHING AND SCREENING PLANTS

Austin-Western Company—Bulletin No. 1999 describes the latest Austin-Western two-unit and three-unit portable crushing and screening plants which have been developed for either pit or quarry use. How these plants are capable of delivering high tonnages of aggregate in accurately controlled sizes; and how the three units (primary breaker, primary and secondary) may be used separately or in combination, as desired, providing flexibility of operation, is contained in the bulletin.

24 DETRITOR

The Dorr Co.—A 24-page, two color bulletin, No. 6411, entitled "The Dorr Detritor" contains drawings, photos and complete descriptions of the various types and sizes of the unit for the removal of grit from sewage and trade wastes. Also included are eight pages of data and charts dealing with the basic principles of grit chamber design.

25 DIAMOND AND SHOT CORE DRILLS

Acker Drill Company, Inc.—Bulletin No. 33 describes a complete line of lightweight portable core drills and soil sampling equipment. It also describes both diamond and shot type drill rigs, their uses and applications.

26 DIAMOND DRILLING

Herb J. Hawthorne, Inc.—offers a folder on diamond drilling which discusses the adaptation of drilling bits of the seismic exploration industry of the petroleum industry to other fields and particularly the diamond drilling field.

27 DIESEL CRAWLER CATALOG

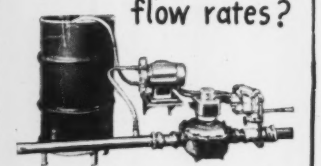
International Harvester Co.—A 32-page TD-9 diesel crawler catalog, CR-313-A, contains specifications and information on how the crawler develops and applies its 41.3 drawbar horsepower.

1. What ℅℅ were speed demons in Nero's day?

2. What ℅℅ drive slow freight through mountain country?

3. What ℅℅ make quick work of wet roads in Venice?

4. What ℅℅ will help you feed chemicals at speeds to suit water flow rates?



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CATALOG DIGESTS

28 DIRECTIONAL COMPASS TRANSIT

Henry Wild Surveying Instrument Supply Co.—A fully illustrated pamphlet describes the T-O directional compass transit. Its horizontal circle can be used as fixed scale or, by depressing a lever in the base of the instrument, as swinging compass. This makes the T-O a "two-in-one" instrument which is extremely versatile for general surveying problems, construction and forestry engineering.

29 DOORS

Kinnear Manufacturing Co.—A catalog and data book just published discusses fully and illustrates the advantages, the economy, the construction features, and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 68, it gives information on installation clearance requirements, methods of operations and controls, as well as the adaptability of the doors for many types of uses.

30 DRAFTING SUPPLIES

Berger Scientific Supplies, Inc.—will furnish upon request its well illustrated catalog describing a complete line of drawing instruments, slide rules, T squares, curves, triangles, scales and other equipment for architects, engineers and draftsmen.

31 DRAINAGE PRODUCTS

Republic Steel Corp.—A 20-page booklet, "Engineering Data—Toncan Iron Sectional Plate Pipe, Arch-Pipe, Arches" gives necessary information on design, size, weight, etc., of shop fabricated structures for re-assembly on site. Valuable for engineers, contractors, draftsmen, and purchasing agents.

32 DRAWING PEN

John Henschel and Co., Inc.—Imported Pelican Graphos, the drawing ink fountain pen, has 54 changeable nibs for art lettering, technical drawing and sketching. Points draw lines from a hairline to 3/8 in. thick. Also available is Pelican ink in nineteen vivid colors. Write for free literature and color samples.

33 DRAWING PENCILS

J. S. Staedtler, Inc.—has imported Mars Lumograph drawing (wooden) and artist (chuck) pencils as well as lead refills. They come in nineteen degrees, from EXEXB to 9H with accurately graded leads. A sample and folder will be sent on request.

34 DREDGING

Ellicott Machine Corp.—Catalogue 825 will be useful and informative to everyone interested in dredging. A general section describing the operating advantages of the different types of dredges is followed by an illustrated section showing how Ellicott hydraulic dredges have been used in harbors, canals, ports, rivers, reservoirs, dams, beaches, lakes and real estate developments to remove solids or produce fill material. Basic information on the selection of dredges is also included.

35 DYNAMOMETER BOOKLET

General Electric Co.—A two-color booklet on G-E Type TLC (cradled), 250-volt, d-c dynamometers for direct connection testing of internal combustion engines, electric motors, pumps blowers, and compressors, has been announced. Designated as publication GEA-5552, the bulletin describes the features of the equipment, its applications and operation. It is illustrated with a number of actual installation photographs, a cutaway view of a dynamometer, a table of full-load horsepower and speed ratings, and a chart showing typical performance curves.

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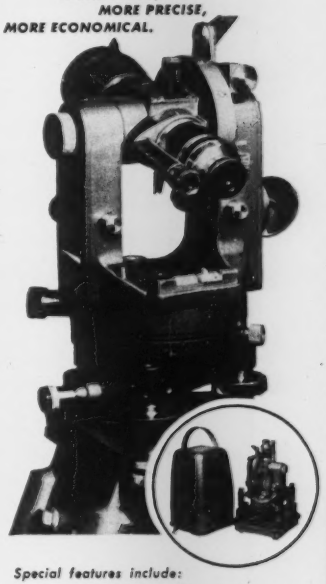

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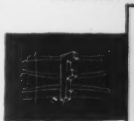

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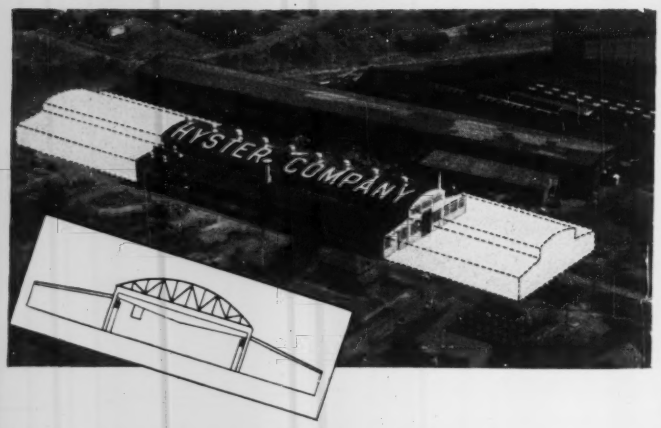

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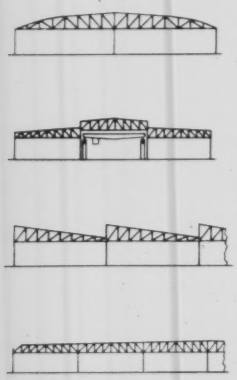

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CATALOG DIGESTS

36 ECHO DEPTH RECORDER

Bludworth Marine Div. of National-Simplex-Bludworth, Inc.—A specification sheet describing Model ES-123 Supersonic Echo Depth Recorder is offered. This instrument provides a permanently recorded graph of underwater contours as well as an indication of the constituency of bottom materials. Underwater survey groups, dredging companies, bridge builders and underwater pipeline companies will find this equipment most interesting.

37 EFFECTS OF CALCIUM CHLORIDE

Solvay Sales Div., Allied Chemical & Dye Corp.—has prepared a 40-page semi-technical booklet, of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.

38 ENGINEERING INSTRUMENTS

W. & L. E. Gurley—An illustrated 64-page catalog, No. 50, describes the complete line of Gurley engineering instruments. Descriptions and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories are listed. Dip needle, cruising and geologists compasses are included, as well as current meters, water level recorders and wind instruments.

39 EQUIPMENT

Joy Mfg. Co.—offers a 16-page booklet on equipment such as: spaders, rock drills, drill bits, wagon drills, portable air compressors, paving breakers, backfill tampers, sheeting drivers, trench diggers, drifters, etc. Numerous photos, charts and specifications are included.

40 FIELD, LEVEL, AND TRANSIT BOOKS

Wilson Jones Co.—has a circular describing a broad line of field, level, transit, topographical and cross section books. Forms are lithographed on water repellent paper. There are loose leaf and bound book styles. Ask for Circular D-1115.

41 FLASH MIXERS AND FLOCCULATORS

The Dorr Co.—The 8-page, two-color Bulletin No. 6971, entitled "Dorrco Flash Mixers and Dorrco Flocculators" contains photographs and complete descriptions of these units as well as the advantages attending their use. This bulletin also covers the various types of Dorr sedimentation units and illustrates by photographs and drawings the ease with which the flocculator operates in combination with these units.

42 FLOO GRATINGS AND STAIR TREADS

A. O. Smith Corp.—Bulletin RR-250 on industrial floor gratings and stair treads is offered. A table of safe loads, panel widths, photographs and diagrams are contained in the informative bulletin.

43 FLUORIDATION

Proportioneers, Inc.—Bulletin SAN-9 gives the complete story on the feeding of fluorides for the reduction of dental caries. It explains the methods of feeding sodium silico-fluoride and hydrofluoric acid under pressure. Special attention is given to the accurate control of feeding in strict proportion to the flow. Equipment is described for feeding into pressure line.

When ordering literature for which there is a charge, please make checks payable to the company offering the material!

CATALOG DIGESTS

44 FOOTWALKS

Wm. F. Klemp Co.—offers a 1951 edition of their catalog entitled "Klemp Open Steel Grating and Stair Treads, the Perfect Structural Steel Flooring," containing information on riveted and welded grating, structural steel footwalks, bridge decking and drain grating, for use in refineries, power houses, sewerage units, mezzanine storage rooms, catwalks, heavy industries, bridges, etc.

45 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

46 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc.—Literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations: Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

47 FOUNDATIONS AND SOIL BORINGS

MacArthur Concrete Pile Corp.—A booklet giving concise data on pile foundations describes cast-in-place, composite, steel, sectional pipe, timber and H piles. Also given are notes on soil and rock exploration, and pile driving problems with special notes and engineering information covering 42 years' experience installing cast-in-place concrete piles.

48 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating-flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plant and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.

49 GRID ROLLER

Hyster Co.—A 10-page pictorial and verbal description of how, where and why the grid roller process has proved a better, less expensive and faster way of reclaiming and maintaining bituminous roads is offered.

50 GUNITE

Pressure Concrete Co.—has a 48-page illustrated booklet on "Gunite" in all of its phases. This booklet contains specifications, job stories, and illustrations showing "gunite" repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks, bunkers, etc.

51 HEAVY DUTY MACHINE

American Steel Dredge Co., Inc.—offers a bulletin on "The Bushwacker," a heavy-duty machine for clearing land through the disintegration of brush, vines, undergrowth and trees. It contains information on its construction, operating principles and performance, as well as many action photographs.

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CATALOG DIGESTS

52 HOT PROCESS WATER SOFTENERS

Permutit Co.—Bulletin 2341 illustrates and describes new hot process water softeners. This equipment is especially designed to condition boiler feedwater so as to protect tubes and drums against scale and corrosion and inhibit caustic embrittlement.

53 HYDRANTS AND GATE VALVES

R. D. Wood Co.—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel, containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

54 HYDRAULICS CALCULATOR

American Concrete Pipe Assoc.—A circular slide rule based on the Manning Formula is available to engineers. It will solve problems involving rates of flow, velocities, or slopes for pipes from 4 to 72 in. in diameter. Roughness coefficient "n" can vary from 0.008 to 0.020. Rate of flow can be in gallons per minute, million gallons per day or cubic ft per second. Price is $3.00.

N. B. There is a charge for this slide rule. Make checks payable to the American Concrete Pipe Assoc.

55 HYDRAULIC PULLERS AND JACKS

Templeton, Kenly and Co.—An 8-page bulletin, Hydraulic 51, discusses labor-saving applications of hydraulic pullers and jacks. The bulletin also introduces Simplex Re-Mo-Trol hydraulic pumps and remote-controlled rams. It illustrates how these units simplify rigging requirements and improve safety in numerous pulling, pushing and lifting ope ations, by means of "center-hole" tubular ram construction. Complete specifications of Re-Mo-Trol units and all other hydraulic jacks and jennies are included.

56 HYDROLOGIC DATA

Leupold and Stevens Instruments, Inc.—The Stevens Data Book is 5 by 8 in. and contains 150 pages of information on float wells and recorder installations, hydraulic tables, conversion tables and a wealth of other hydrologic data useful to hydraulic engineers.

57 INSTITUTIONAL BROCHURE

Pittsburgh-Des Moines Steel Co.—A complete presentation of the company and its many steel plate and structural products is made in a handsomely illustrated 32-page brochure, Bulletin 701. Beginning with an historical note on the development of the company, the publication shows production facilities of three plants, and pictures extensively the broad work of the firm in construction of elevated steel tanks, reservoirs, wind tunnels, pressure and vacuum spheres, storage tanks and bins, etc.

58 LAYKOLD FIBRECOAT

American Bitumuls Company—An illustrated booklet describes Laykold Fibrecoat, a mineral-armored asphalt for cold application, to protect bituminous and metal surfaces.

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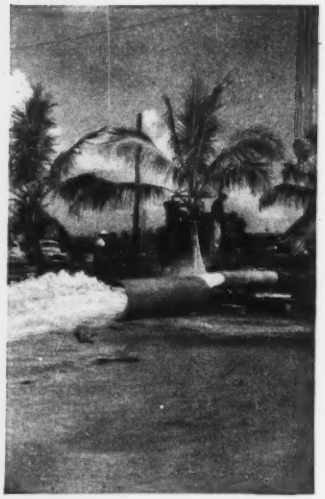

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Ultimate tensile strength lbs. per sq. in.						
Sand Cast	125,000	115,000	108,000	100,000	90,000	85,000
Rolled 1" and under	.....	120,000	110,000	105,000	95,000	85,000
Rolled or Forged, over 1"	.....	115,000	108,000	100,000	90,000	85,000
Yield Point (divider method)						
Sand Cast	95,000	75,000	60,000	55,000	45,000	40,000
Rolled 1" and under	.....	75,000	65,000	60,000	50,000	45,000
Rolled or Forged, over 1"	.....	75,000	65,000	60,000	50,000	45,000
Elongation in 2"—%						
Sand Cast	10	12	14	15	20	25
Forged or Rolled	.....	12	13		15	20
Reduction in area—%						
Sand Cast	.....	12	14	15	20	25
Forged or Rolled	.....	12	13		15	20
COMPRESSION						
Yield Point—lbs. per sq. in.	70,000	65,000	58,000	50,000	40,000	35,000
Permanent Set at 100,000 lbs. per sq. in. (max.)	.015	.020	.030	.050	.080	.125
Brinell hardness, No.	250	240	220	200	175	150

List of U. S. Government Specifications Covering HY-TEN-SL Bronze

ARMY
Forgings, Rolled Rod QQ-B-721 Class B
Castings...QQ-B-726 Class B and C

NAVY
Forgings and Rolled Rod 46B15d Class B
Castings, Aluminum-manganese Bronze 46B29

WATERTOWN and OTHER ARMY ARSENALS
Castings WXS-5
Forgings and Rolled Rod.....WXS-2

NAVAL GUN FACTORY
Washington Navy Yard
Castings—Trunnion Metal.....O:S.550

AIRCRAFT
See Navy and Army (above).

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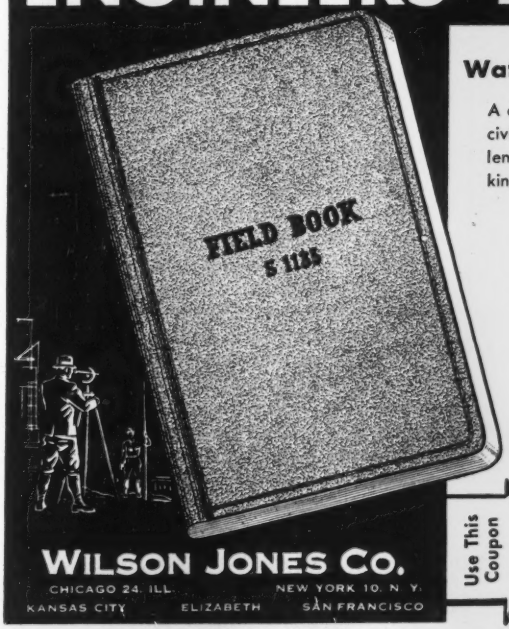

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CATALOG DIGESTS

59 LINE PIPE

A. O. Smith Corp.—In Bulletin No. 576, the Smithway process of making line pipe is described. Numerous photographs and sketches show step by step how the pipe is produced. Practical advantages of the pipe are listed and a table of sizes and weights is included.

60 MAGNESIUM FRAMED FORMS

Symons Clamp & Mfg. Co.—A 14-page, well illustrated booklet, tells all about plywood forms in magnesium frames, for those in the construction field interested in new, modern methods of form construction. Plywood faced panels in magnesium frames are readily interchangeable with all magnesium panels. General direction for setting up and caring for the forms are also included in the booklet. Ingenious accessories further simplify the use of Symons forms.

61 MAIN STERILIZATION

Proportioneers, Inc.—Bulletin No. SM-9365, is a standard method bulletin on main sterilization and gives directions, calculations, typical main sterilization specifications, a water main sterilization chart and a description of the equipment required.

62 MASONRY & CONCRETE DIAMOND BLADES

Clipper Manufacturing Co.—Information on metal bonded diamond blades for cutting hard vitreous materials with masonry or concrete saws, is contained in Circular No. 134. Blades are available in numerous specifications in bronze, nickel or steel bonds for cutting two to three times faster with smooth effortless results.

63 MASONRY SAWS

Clipper Manufacturing Co.—Circular No. 163 illustrates and explains wet and dry cutting masonry saws and the speed of cutting brick, glazed tile, concrete block, stone and all masonry materials. Information is given on free trial and Clipper convertible "4 in 1" saw.

64 MECHANICAL PIPE JOINTS

R. D. Wood Co.—A 4-page leaflet describing mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

65 MOTOR GRADER

Allis-Chalmers Mfg. Co.—A neat 20-page, two-color catalog presents the 34.7 hp model D motor grader. It has such popular features as tandem rear wheel drive, tubular frame and rear mounted engine transmission for improved visibility.

66 MOTOR GRADERS

Allis-Chalmers Mfg. Co.—A 24-page, two-color catalog presents the AD-4, 104 hp and AD-3, 78 hp motor graders. Many action pictures illustrate the advantages and usefulness of the large equipment. The many plus features are described in detail and cutaway views provide close up inspection of the power supply, transmission and final drive.

67 MOTOR OIL

Standard Oil Co. (Indiana)—The booklet entitled "Stanolube HD Motor Oil" is a technical description and definition of heavy duty motor oils, illustrating through charts, photographs, and other data how Stanolube HD has demonstrated its ability to cope successfully with the most difficult problems of lubrication in automotive, diesel and HD engines.

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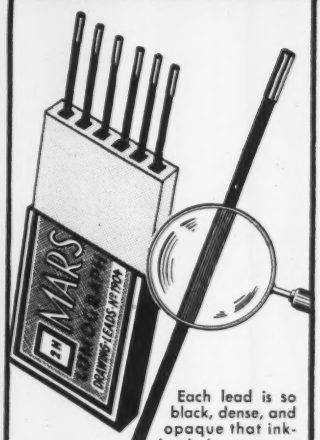

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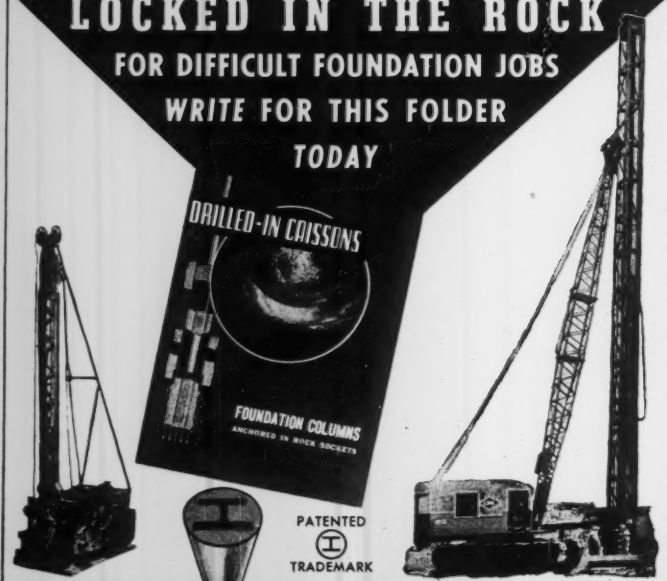

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CATALOG DIGESTS

68 MOTOR SWEEPER

Austin-Western Co.—An 8-page catalog, AD-2042, pictures and describes the Model 40 motor sweeper with its unique direct broom-to-hopper sweeping which makes unnecessary the conventional belt conveyor or squeegee elevator. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in the catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

69 PACKAGED ELECTRIC POWER

General Electric Co.—A 24-page bulletin on packaged electric power for industry's third—and biggest expansion is now available. Designated as bulletin GEA-5600, the publication outlines methods of obtaining electric power equipment for quick expansion at low cost and with a minimum of critical materials. The publication also offers a list of 31 other G-E bulletins giving full information on available equipment for industrial power expansion.

70 PANELS

Symons Clamp & Mfg. Co.—A bulletin features Symons panels with steel cross members. The bulletin illustrates three different size panels as well as the individual pieces used in constructing the steel cross members. Also included is a chart showing the hardware required for these panels.

71 PENCILS

J. S. Staedtler, Inc.—A folder and sample of the imported tradition chroma colored pencils for blue print as well as general use, is available. They come in sixteen colors including four for blue prints. Strong leads are not water soluble. They sharpen to fine or blunt point.

72 PENCIL SKETCHING

American Lead Pencil Co.—24 pages of helpful illustrated instructions on pencil sketching. Only 25¢ with two free Venus drawing pencils.

N. B. There is a charge for this book. Make checks payable to the American Lead Pencil Co.

73 PHOSCOTE PROCESS

Chicago Bridge and Iron Co.—An 8-page booklet entitled, "The Phoscote Process" contains information on the pickling and painting of steel plates, angles, channels and other shapes produced by rolling. The booklet contains photographs and drawings showing the various operations during the Phoscote process.

74 PILE HAMMERS ON BRIDGE PROJECT

McKiernan-Terry Corp.—Bulletin 62 describes the methods of building the foundations and driving the piles for the construction of the Chesapeake Bay Bridge, now nearing completion. The illustrations in the bulletin include a birds-eye drawing of the bridge and its approaches, an elevation sketch, and more than a dozen other views showing the successive steps in the progress of the construction of the bridge.

75 PILES

Raymond Concrete Pile Company—Raymond Standard and Step-Tapered Piles are described in literature which also includes information on the scope of Raymond's activities which cover every recognized type of pile foundation including cast-in-place concrete, precast concrete, composite, wood and concrete, steel, pipe, and wood. Raymond's activities and experience also include the construction of caissons and construction involving shore protection, shipbuilding facilities, and harbor and river developments.

76 PILES AND CAISSONS

Western Foundation Corp.—An 8-page bulletin on concrete piles and caissons is offered. Services performed by Western Foundation are enumerated and seven types of cast-in-place concrete piles such as: the button bottom, concrete pedestal, compressed concrete, and wood composite, are outlined in the catalog.

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CATALOG DIGESTS

77 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co.—has descriptive information and engineering data on Monotube steel piles. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile-driving equipment without use of driving core or mandrel. Advantages listed: easy handling, speedy driving, economical field extendability, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

78 PIPE CEMENT LINING

Centriline Corp.—A booklet describes the method of reconditioning pipe lines in place by placing a cement mortar lining on the inside surface which will stop leaks, corrosion and increases flow coefficients. This work can be done in pipe diameters from 4 in. to 144 in. with a minimum interruption of service.

79 PIPE INSTALLATION GUIDE

Johns-Manville Corp.—A 124-page pocket size manual covers all phases of the installation of transite pressure pipe for municipal water lines. Its contents are arranged and indexed for easy reference so that the answers to practical problems, as they occur on the job, can be found at a glance. Ask for Brochure TR-62A.

80 PIPE LININGS

Pipe Linings, Inc.—"Tate Process," a 10-page, illustrated, multicolor bulletin covers a method of lining smaller diameter water, oil, or gas pipe lines "in place." The service cleans corroded matter and tubercules from pipe walls and applies smooth cement-mortar lining.

81 PITOT EQUIPMENT

Simplex Valve & Meter Co.—Bulletin No. 1300 is a complete publication on the choice and use of Pitot equipment. Descriptive material covers instructions for use of Simplex Pitot tube and manometer, instructions for operation and use of Simplex portable Pitot recorder and, in addition contains an entire section applied to theory, formulas, notations, tables and curves relating to Pitot tubes, manometers and recorders.

82 PLUNGER PUMP

The Dorr Co.—An 8-page, two color bulletin No. 5182 contains photos, drawings, description and sample specifications for the Dorreo plunger pump—a dependable unit expressly designed for pumping sludges in water, sewage and industrial water treatment plants. Information on preferred arrangements and sizes and capacities is also given.

83 POCKET TRANSIT

Wm. Ainsworth & Sons, Inc.—A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by an instrument weighing only 8½ ozs.

84 PORTABLE DRILL

Pennsylvania Drilling Co.—offers a bulletin describing a light weight portable drill for drilling holes from ½ in. to 4½ in. in diameter by using various sizes of diamond bits and core barrels. Holes may be drilled at any angle, and through practically any material such as concrete, reinforced concrete, marble, granite, cement, sandstone, brick and glass.

85 POWER GRADERS

Austin-Western Co.—A 24-page catalog AD-2112 pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

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CATALOG DIGESTS

86 PRECIPITATOR

Permutit Co.—Bulletin 2204A describes the Permutit precipitator which offers a new and more efficient means for removing impurities from water by precipitation, absorption, settling and upward filtration.

87 PRECISION-BUILT CEMENT FLOORS

Kalman Floor Company, Inc.—An illustrated 8-page catalog describes the Kalman process, a precision method of building in maximum hardness and density uniformly over complete floor areas. The laying of one of these granolithic cement floors in a typical plant shows in detail the underslab preparation, preparation of proper-aggregate Kalman topping mix, absorption control, compacting, surfacing, troweling and curing.

88 PRESSURE-CREOSOTED PILES

Koppers Co.—A 16-page booklet designed to assist engineers in the evaluation of pressure-creosoted foundation piles for various types of construction projects has been issued. The booklet cites important national, regional, and city construction codes which allow pressure-creosoted wood foundation piles for permanent construction. Typical examples of the use of these piles are described and pictured.

89 PRESSURE FILTERS

Permutit Co.—Bulletin 2225-A describes the line of pressure filters for removal of dirt, turbidity, iron, oil and color from water. Included are those which employ highly absorptive media to remove bad taste and odor. The bulletin also covers the unique multiport valve control which greatly simplifies filter operation and saves operator's time.

90 PRESSURE GROUTING INFORMATION

Gardner-Denver Co.—offers Bulletin P-60 on pressure grouting information. Construction details of the Duplex high pressure steam pumps for grouting service, stationary air compressors, and hand held drills are given, and are supplemented with charts, diagrams and illustrations and other informative matter.

91 PRESSURE VESSELS

A. O. Smith Corp.—offers Bulletin No. V-44 on field assembly of pressure vessels the Smithway. Illustrations show how some of the many special and unusual problems encountered in vessel production are handled. Further photographs show how the vessels are field-assembled, and four pages of specifications for pressure vessels are included.

92 PRINT MARKING PENCILS

Eberhard Faber Pencil Co.—announces a new assortment box No. 4006 of six scientifically chosen colors recommended for reproduction. The six Colorbrite pencils included were selected for high-visibility on every type of print, are brilliant even under dim lighting, corrections won't smear, won't fade, won't blur when wet. These colors include: light blue, chrome yellow, white, orange, scarlet, and light green. A free sample of any two colors will be sent on request.

93 PRODUCTS AND PROCESS

Infilco Inc.—"Products and Processes for Industry" is a comprehensive bulletin recently published. It is a worthwhile manual for all who are responsible for the selection of water conditioning, sewage and trade waste treatment equipment.

94 PUMPS

Economy Pumps, Inc.—A line of general purpose pumps, type SCC, are described in Catalog No. D-851. Pumps are suitable for small cooling tower or air conditioning system, water circulation, domestic water supply, hot water heating system circulation, etc. Catalog gives applications, descriptions, construction details, performance curves and list prices.

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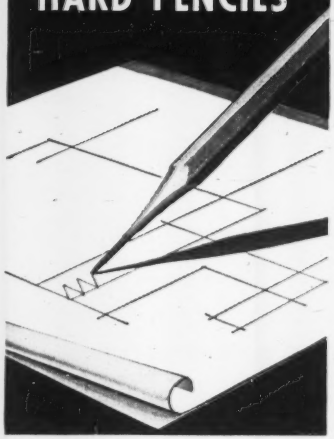

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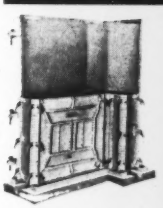

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CATALOG DIGESTS

95 PUMPS

Economy Pumps, Inc.—A 448-page data book, 4 3/4 in. by 8 1/4 in., with flexible binding, contains general information on centrifugal pumps, principles of pump engineering, general engineering data and selection tables on centrifugal, axial and mixed flow pumps. This book is priced at $3.00.

N. B.—There is a charge for this book. Make checks payable to Economy Pumps, Inc.

96 RECTANGULAR STEEL FLOORING

Kerlow Steel Flooring Co.—An informative folder is complete with illustrations, blueprints, charts and descriptive matter on the strongest steel bridge flooring that Kerlow has ever made. IQ-35 is made with grating parallel with traffic and also transverse to traffic.

97 REPRODUCTION MATERIALS

Eastman Kodak Co.—The publication entitled, "Modern Drawing and Document Reproduction," describes in considerable detail the characteristics and properties of Kodograph reproduction materials. These materials have been specifically designed to quickly, easily and at low cost reproduce copies of any written, typed, drawn, or printed matter. The papers are silver-sensitized photographic materials and produce results of unexcelled quality, lasting legibility, and outstanding uniformity. Kodagraph chemicals, Kodalith films and papers, and Kodagraph micro-file equipment are also described in the booklet.

98 RESEARCH TEAM

International Harvester Co.—has a 12-page picture story, CR-457-A, of International Harvester's 290-man research team checking the company's products for quality from design to delivery.

99 RETAINING WALLS

Armco Drainage & Metal Products, Inc.—A 16-page booklet, "Armco Bin-Type Retaining Walls," describes how the retaining walls are used and how strength plus flexibility is incorporated in their design. Photographic descriptions show how they are simply and economically installed with a minimum of excavation. Case histories also show application of the walls for embankment stabilization along highways, railroads, lakes, streams, and city streets. Technical data on selection of walls for typical applications is also included.

100 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems either by cutting off such flows entirely during storm periods or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

101 SHEET PILING CATALOG

Inland Steel Co.—A 12-page booklet gives complete descriptions and specifying data on Inland's sheet piling sections and accessories plus photographs of typical applications.

102 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company—A general description of the complete line of Simplex equipment is offered in Bulletin 002. The bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controliers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment air inlet and air release valves.

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103 SINGLE-PHASE INDUCTROLS

General Electric Co.—A bulletin on G-E single-phase inductrols (low-voltage, dry-type induction voltage regulators) has been announced. Designated as publication GEC-795, the bulletin describes the features of the redesigned inductrol equipment, its application and operation. It also contains sketches, line drawings, and charts showing operating connections.

104 SOIL TESTING

Soil Testing Services, Inc.—A 12-page catalog, No. 3-51, on new products in the soil testing apparatus line has been released. Included in the items illustrated and described in the bulletin, are the Soiltest models of triaxial and consolidation apparatus and accessories, paraffin warmers, dispersion mixers, direct shear apparatus, laboratory, and field California bearing ratio apparatus, humidifiers, etc.

105 SPECIFICATION BOOK

American Association of State Highway Officials—has just released, "Specifications for General Provisions." The publication covers all of the general items that precede any book of specifications, giving the definitions for the many terms, the scope and control of the work. It is priced at $2.00.

N. B. There is a charge for this book. Make checks payable to the American Association of State Highway Officials.

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106 SPEED-LAY PIPE SYSTEMS

Albert Pipe Supply Co., Inc.—A 5-page brochure describing "packaged" pipe line for temporary and semi-permanent air, gas and water lines is offered. This line is available in sizes 2 to 12 in., or larger if desired. It is lightweight, portable, easily assembled and available for prompt shipment. Includes pipe, couplings, fittings, adapters and valves where necessary.

107 STEEL BEARING PILES

United States Steel Co.—A 100-page book presents comprehensive data and illustrations of the current practice in the design and use of the new steel CBP section bearing piles. In addition, there is an extensive review of the use of steel bearing pile sections, with records of tests of the past uses and applications.

108 STEEL FLOORING INSTRUCTIONS

Wm. F. Klemp Co.—offers its 1951 edition of a technical manual entitled "Instructions for Laying Klemp Hexteel and Floor-steel." Hexteel heavy duty surface armor is an open-steel grid, solid, enduring and self-anchoring. Floorsteel flexible floor armor is an open steel mat. Both are used to armor and reinforce bridges, docks, air landing strips, loading platforms, industrial floors, heavily traveled highways and catalytic cracking units. The book contains complete engineering data.

109 STEEL SAVING CONCRETE PILES

MacArthur Concrete Pile Corp.—A booklet points out foundation piling solutions in face of present critical steel shortages and discusses service-proven use of straight-shaft and pedestal concrete piling for foundation use. It also gives notes on all MacArthur driving methods for standard piles, and list of available client service, soil and rock exploration, engineering services covering 42 years' foundation pile experience.

110 STEEL SHEET PILING

United States Steel Co.—A 56-page booklet gives detailed discussion of the uses, characteristics, and assembly of the three general types of steel sheet piling sections, the straight web, the arch web, and Z-piles. Following this discussion are complete tables of wall dimensions, cellular structures, accessories, and weights for all sections, plus diagrams of the individual sections, walls, corners, cellular structures, cofferdams, bulkhead and piers, and caps or copings.

111 STRUCTURAL SHAPES

United States Steel Co.—Attractive 72-page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate-size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails, and corrugated sheets.

112 SURVEYING ALTIMETER

American Paulin System—has a catalog giving specifications on Micro and Terra surveying altimeters together with comparative explanation of instrumentation systems in this field.

113 SURVEYING ALTIMETER DEVELOPMENT

American Paulin System—offers their interesting and instructive publication entitled "Origin and Development of the Barometer and Altimeter." This booklet will acquaint civil and field engineers with the basic differences between their system of instrumentation and all other types in the field of surveying altimeters.

114 SURVEYING INSTRUMENTS

C. L. Berger & Sons Inc.—Catalog "F" describes the full Berger line of transits, levels, theodolites, alidades and special instruments made by that company for 80 years. A well illustrated brochure (N 648) is available on request for preliminary information.

115 SURVEYING MICRO BAROGRAPH

American Paulin System—offers a folder giving specifications on a surveying barograph eliminating personnel error and cost of map at base.

116 SYNCHRONOUS GENERATORS

General Electric Co.—A 4-page, two-color bulletin, GEA-5470, on Tri-Clad high-speed synchronous generators is offered. The publication covers generators for standby, portable, and prime-source power in ratings from 1.875 to 50 kva with frequencies of 60 to 400 cycles. Well illustrated with product pictures as well as cutaway and exploded-view photographs, the publication enumerates construction features of the generators and includes a comparison table of ratings.

117 TECHNICAL BOOKS

John Wiley & Sons, Inc.—Information on authoritative, up-to-date technical books in all branches of science and engineering is available in the Wiley general catalog. Of particular interest to civil engineers are the descriptions of standard reference and textbooks on structural engineering, foundations, hydraulic and hydroelectric engineering, municipal engineering, architecture, irrigation, highway and bridge engineering, building construction, and many other related subjects.

118 TECHNICAL DATA CATALOG

Lefax—The 1951 Lefax Catalog contains over 2000 listings of Lefax pocket-size technical books. Each book consists of approximately 140 pages of easily read tables and data in loose leaf form for handy reference right on the job. Subjects listed include: hydraulics, machine design, piping data, surveying tables, metallurgy, analytical chemistry, highway engineering, etc.

119 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

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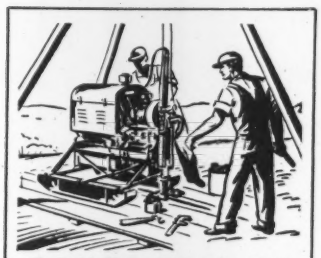

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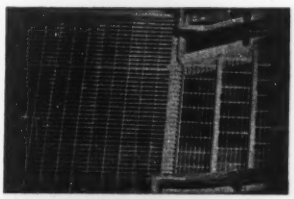

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CATALOG DIGESTS

120 TORSIONAL STRESSES

Bethlehem Steel Co.—A short treatise contains information of interest to engineers and designers who may find torsional loads arising during structural analysis. It gives the formulas covering certain typical cases, and assists in their application by tabulating the values of several complicated functions appearing therein. Ask for Booklet S-57.

121 TOWING WINCH

Hyster Co.—An 11-page manual shows the operator how to use the D7N towing winch to obtain maximum performance and to realize full utility of the winch.

122 TRACING PENCIL TEST KIT

American Lead Pencil Co.—The kit contains samples of Venus tracing pencils for testing on various types of tracing papers. This new pencil contains an active chemical to produce clearer, sharper white or blue prints when reproduction is made from a pencil drawing.

123 TRACTORS

Caterpillar Tractor Co.—A 40-page booklet, entitled "Caterpillar Products" contains a complete listing with pictures and brief specifications of all but two of the current line of products, 81 in all. The list of additions ranges from tractors to tool bars. Several application pictures show "Cat" diesel tractors and motor graders in action.

124 TRANSITS & LEVELS

Warren-Knight Co.—A 64-page illustrated catalog gives complete details of design and construction of various models of transits and levels and includes also a small catalog of the most frequently used engineering equipment and drafting-room supplies.

125 TUNNELING

Commercial Shearing & Stamping Co.—Now available is a text book on tunnels and an introduction to tunnel geology by tunnel men. Entitled "Rock Tunneling with Steel Supports" by Karl Terzaghi, the book deals with specific information on tunneling, covering 300 subjects. The most comprehensive book of its type ever offered to the tunnel builder and designer. Price $2.50 per copy postpaid.

N. B. There is a charge for this book. Make checks payable to the Commercial Shearing & Stamping Co.

126 TUNNEL MIXERS

Worthington Pump and Machinery Corp.—Bulletin R-1700-B5, describes in detail Worthington's 35s dual drum tunnel mixers. Features and attachments designed for lower operating costs are presented with illustrations and descriptive matter. A page devoted to specifications and one to "Blue Brute" products for tunnel work is also included.

127 TURBINE PUMPS

Johnston Pump Co.—A vertical turbine pump for every fluid-moving job is the theme of two booklets just issued. The text deals with pump applications and explains the construction features of both oil and water-lubricated pump types. Sectional drawings show the component parts of the pumps and explain their relation to each other. Bulletin 1013 tells the story of oil-lubricated pumps and Bulletin 1014 describes the water-lubricated type.

128 VACUATOR

The Dorr Co.—The 12-page, two-color Bulletin No. 6301, entitled "The Dorreo Vacuator" describes the modern unit in detail including installation photos, drawings and flowsheets illustrating its various applications in sewage treatment. The vacuator is a compact unit utilizing the principle of vacuum flotation and is giving remarkable results on a wide variety of municipal and industrial wastes.

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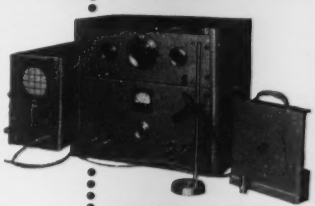

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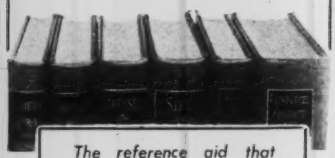

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CATALOG DIGESTS

129 VENTURI METER

Simplex Valve & Meter Co.—Bulletin No. 401 describes in detail the operation and installation methods of the type H meter register. This is a circular-type chart instrument equipped with various forms of mountings and arranged for operation under the majority of hydraulic head conditions. A complete pipe size and meter capacity table provides a quick and ready reference when needed. This bulletin is of essential interest to any filter plant or sewage plant designing engineer.

130 VERTICAL TURBINE PUMPS

A. O. Smith Corp.—Bulletin PI-178-C on Smith-way vertical turbine pumps shows the background of research and engineering behind each pump, how they are engineered for year-in, year-out dependability, and how the design provides maximum adaptability. Photos and construction details are included.

131 VIBRATING SCREENS

Link-Belt Co.—20-page Book No. 2377 describes Model "Up" vibrating screens for the fast, accurate dry-screening of light and fine materials, and Model "NRM" liquid vibrating screens for the low-cost, high speed separation of solids from liquids. Descriptive material includes specific information on how to select the right screen and screen cloth for maximum operating efficiency; dimension tables, weights, horsepower requirements, and other data of value to the engineer and plant operator.

132 WALL-FORM CONSTRUCTION

Symons Clamp & Mfg. Co.—A 34-page catalog on a system of wall-form construction is available. Illustrations show in detail how simply and easily the forming system operates. Actual jobs where Symons forms have been used are well illustrated—showing the forms in use as well as completed foundations. Also blue print illustrations and complete specifications are given—material and equipment necessary, time required and cost figures on actual jobs. The manufacturer advises that, by sending in plans and specifications, you will be furnished a free form layout of your job without charge or obligation.

133 WALL FORMS

Symons Clamp & Mfg. Co.—offers an 8-page revised Directions Booklet on Symons wall forms. Complete details are given for the erection of the forms including panel alignment, stripping, spacing of ties, safe work load for ties and pressure per square foot that the forms will stand. Complete illustrated information on the many accessories is also included.

134 WASTE TREATMENT

Infilco Inc.—"Waste Treatment to Comply with Stream Pollution Control Regulations" is the title of Bulletin 70-A, explaining the "how" techniques of chemical, biological, and anaerobic waste treatment. It gives case histories and data of value to those responsible for waste treatment.

135 WATER AND SEWAGE PLANT EQUIPMENT

Infilco Inc.—Equipment for municipal water and sewage plants is covered in Bulletin 60-C, just recently revised. It includes the latest equipment available for efficient, economical water conditioning and sewage treatment.

136 WATER CONDITIONING UNIT

Infilco Inc.—offers Bulletin 1825 which has 28 pages of information on historical development, distinguishing characteristics, advantages, design considerations, operation and applications of the Accelator water conditioning unit. Diagrams clearly explain the Accelator and show typical layouts.

137 WATER FILTERS

Proportioneers, Inc.—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specifications and dimensions covering the complete recirculation and purification systems, are given.

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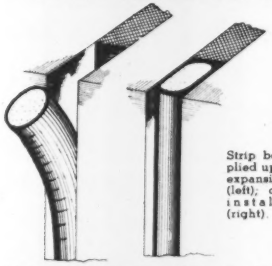

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CATALOG DIGESTS

138 WATERPROOFING

Western Waterproofing Co.—has a comprehensive guide showing how to protect both new and old structures from: above-grade water penetration with Resto-Crete system and Dilato expanding mortar; interior wall dampness with Parge coat; sub-surface water seepage with Ironite. Detailed data and sample specifications for these services are included.

139 WATERPROOFING

Western Waterproofing Co.—A 4-page folder shows how Western has successfully added years to the life of a wide variety of school and university buildings through weather and water-damage protection, building and concrete restoration, tuckpointing and building cleaning.

140 WATERPROOFING AND WEATHERPROOFING

Western Waterproofing Co.—A comprehensive folder explains how to recognize concrete deterioration, what causes damage to concrete masses, and how Western's exclusive "Resto-Crete" system provides lasting restoration and protection of grain elevators and similar structures.

141 WATERPROOFING AND WEATHERPROOFING

Western Waterproofing Co.—A folder shows how the company's complete and highly specialized services have restored, beautified and protected from deterioration a wide variety of churches in all parts of the country.

142 WATER PURIFICATION

Worthington Pump & Machinery Corp.—A 6-page bulletin, No. W-212-B4, describes the operation of a Worthington Ion Exchange water purification system, and illustrates the equipment furnished for the process.

143 WATER PURIFICATION FILTERS

Worthington Pump & Machinery Corp.—An 8-page illustrated bulletin, No. W-212-B3, on pressure filters for water purification describes design, construction, and operation of equipment, and gives table of weights and dimensions of equipment in relation to the capacity needed.

144 WATER SOFTENING

Worthington Pump & Machinery Corp.—A 6-page bulletin, No. W-212-B2, describes and illustrates the operation of a hot process water softening installation, and shows various pieces of Worthington equipment used in the process.

145 WATER SUPPLY LINE

Price Brothers Co.—A pamphlet contains an article describing Rochester's new water supply from Lake Ontario. It tells how a temporary plant was set up for the manufacture of prestressed concrete steel-cylinder pipe on the job, and how this pipe assures a continuing high rate of flow, exceptional watertightness and freedom from corrosion and tuberculation.

146 WELDED FABRIC

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—A 2-color folder describes Clinton electrically welded fabric which has been successfully applied to every form of reinforced concrete construction. Some of its many uses are for concrete roads, streets, airports, floors, pipe, sewers and reservoirs. Structural advantages, ease of use and standard styles are listed.

147 WELLPOINT DEWATERING SYSTEM

John W. Stang Corp.—A catalog describes the component parts of the Stang wellpoint dewatering system; its planning, engineering and various methods of installation. Specific installations on dams, power houses, pipelines, tunnels, etc., are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

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148 WELLPOINT SYSTEM

Complete Machinery & Equipment Co., Inc.—A catalog describing the Complete Wellpoint System, shows its many advantages in installation, operation and cost-cutting economy. Also suggestions for installing the system are clearly stated and illustrated.

149 WELLPOINT SYSTEM

Moretrench Corp.—"Working in the Dry with the Moretrench Wellpoint System" is the title of a 64-page catalog describing and illustrating the Wellpoint system and its use in dewatering various types of construction projects. It is amply illustrated with on-the-job photos.

150 WELL WATER SYSTEMS

Layne & Bowler, Inc.—A booklet titled "Layne Well Water Systems," contains 48 pages crammed with photographs and drawings illustrating methods of drilling deep water wells. Subjects covered are underreamed gravel wall wells, rock wells, and special drilling such as core sampling for foundation soundings. A water conditioning section completes the story of the scope of Layne service. Useful engineering tables are included in the back.

151 WIRE FABRIC

American Steel & Wire Co.—A 178-page catalog furnishes useful information about welded wire fabric to those interested in construction, whether the interest be from the marketing, designing, or contracting viewpoint. The catalog contains tables and photographs showing uses of welded wire fabric.

152 WIRE ROPE

American Steel & Wire Co.—A handy pocket-sized 125-page catalog features all types and sizes of wire rope with tables for each type and size showing rope diameters, breaking strengths in pounds, weight per foot, etc. It also shows fittings and handling techniques.

153 WIRE ROPE

American Steel & Wire Co.—A 40-page wire rope recommendation book contains recommendations for all types of equipment and operating conditions. Prepared as an aid in securing longer wire rope life.

154 WIRE ROPE

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—The new Wickwire rope catalog offers a different approach to this difficult subject. Charts, tables, drawings, and photographs were included to present a fresh slant on wire rope. The catalog covers the characteristics, care, handling and describes wire rope for specific industries.

155 WIRE ROPE—LIFE AND COSTS

Wickwire Spender Steel Div., Colorado Fuel & Iron Corp.—Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78-"right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

156 WOOD AND STEEL FORM

The Irvington Form & Tank Corp.—A circular just issued describes a new type composition wood and steel form. The form, called the Atlas compo form incorporates many new innovations for faster erection and stripping. Full details describing the forms and accessories are included.

157 CONSTRUCTION COST CONTROL

American Society of Civil Engineers—You can save on construction costs with the help of this comprehensive 97-page handbook which provides answers to construction accounting and cost control problems common to all. Authored by experts with many years of field experience, it covers the complete cycle of estimating, accounting, distributing and analyzing of all operational and overhead costs. $4.00 to members, $5.00 to nonmembers, postpaid.

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TIDE GATES

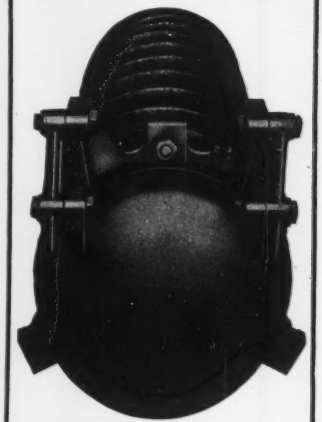

FIG. B-147

Type M-5 Tide Gates for use with Corrugated Culvert Pipe. Bulletin No. 91 describes them fully.

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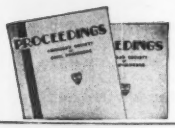

PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 108.

Summarized in Earlier Issues

77. Buckling Stresses for Flat Plates and Sections, by Elbridge Z. Stowell, George J. Heimerl, Charles Libove, and Eugene E. Lundquist.

78. River Channel Roughness, by Hans A. Einstein and Nicholas L. Barbarossa.

79. Stage Predictions for Flood Control Operations, by Ralph E. King.

80. Mississippi River Valley Geology Relation to the River's Regimen, by Harold N. Fisk.

81. Petenwell Hydroelectric Project, by E. Montford Fucik.

Third Notice

82. Pressures in a Shallow Rectangular Bin, by Raymond L. Moore and J. R. Shaw.

83. Waterway Traffic on the Great Lakes, by John R. Hardin.

84. Longitudinal Mixing Measured by Radioactive Tracers, by Harold A. Thomas, Jr., and Ralph S. Archibald.

85. Resinous Ion Exchanges in Water Treatment, by William W. Aultman.

86. Ground-Water Phenomena Connected with Spreading, by Paul Baumann.

Second Notice

87. Sewage Reclamation by Spreading Basin Infiltration, by Ralph Stone and William F. Garber. A field study was completed at two test installations located at Whittier and Azusa, Calif. Sewage effluents and water were spread in basins and percolated to the ground water in order to evaluate the various factors influencing the reclamation process. The Whittier tests were performed in a small basin on a fine sandy loam, while the Azusa work was carried out in a larger basin underlain by coarse gravel soil. Special sampling procedures, hydraulic measurements, soil analyses, bacteriological and chemical tests of the spread fluid, and the percolated effluent were carried out. An evaluation was made of the effects of biochemical oxygen demand, dissolved, oxygen, pH, climate, algae, and chemical pickup on the sewage reclamation process. A simple description and tabulation of the results of all these studies are provided in the write up. The complete hydrological data for the spreading rates obtained at Whittier and Azusa are described. (Available October 1.)

88. Experimental Study of Water Flow in Annular Pipes, by W. M. Owen. Head loss and velocity distribution measurements were made on three annular pipes formed by centrally supporting pipe cores in outer pipes. The fluid used in these tests was water and the range of Reynolds numbers tested was from 4,000 to 700,000. A description is given of the apparatus used and the test procedure. The test results are presented in a series of dimensionless graphs. These results are compared to those of other investigations. A thorough search of the literature revealed eighteen articles on flow in annular pipes that are listed in the bibliography. (Available October 1.)

89. Deflections in Gridworks and Slabs, by Walter W. Ewell, Shigeo Okubo, and Joel I. Abrams. The problems presented in this paper illustrate how horizontal gridworks of rigidly connected beams, with deformation characteristics analogous to those of selected slabs, can be used to develop elastic surfaces under normal loads that are strikingly similar to the surfaces of the original slabs under the same loads. The technique given can be used to determine not only the deflected surface of a slab, but also bending and torsional moments in a slab. This procedure employs an auxiliary force system for controlling vertical displacements of the joints of the equivalent grid system and a single moment and torque distribution process for transmission of the displacement effects. (Available October 1.)

D-30. Discussion of Paper, **Economic Effects of Reservoir Sedimentation,** by William E. Corfitzen. The original paper, published in August 1950, discussed the limits of useful life of reservoirs imposed by sedimentation and gave methods of computing sediment loads, rates, and economics. Discussers are: T. Blench, Martin Maevers, and William E. Corfitzen. (Available October 1.)

D-40. Discussion of Paper, **Construction Technique of Passing Floods Over Earth Dams,** by Andrew Weiss. The original paper, published in October 1950, reported the experience of the author in a new technique of permitting flood flows to pass unhindered over uncompleted earth and rock-fill dams during construction. Discussers are: Cleves H. Howell, Gerard H. Matthes, and Andrew Weiss. (Available October 1.)

D-34. Discussion of Paper, **Lateral Buckling of Eccentrically Loaded I-Section Columns,** by H. N. Hill and J. W. Clark. The original paper, published in September 1950, recorded the results of tests on eccentrically loaded I-section columns and gave the factors involved in the design of a member subject to simultaneous axial compression and transverse bending. Discussers are: Jack R. Benjamin, Jacob Karol, and H. N. Hill and J. W. Clark. (Available October 1.)

D-38. Discussion of Paper, **Hydrology of Mexico,** by Andres García-Quintero. The original paper, published in October 1950, reviewed the factors responsible for the relative scarcity of rainfall in Mexico. Discussers are: Andrew Weiss, Milton O. Schmidt, and Gerald H. Matthes. (Available October 1.)

D-17. Discussion of Paper, **Origin and Significance of Openwork Gravel,** by Allen S. Cary. The original paper, published in May 1950, gave the results of field studies of stream deposits of "openwork" pebbles and boulders without interstitial sand in the Pacific Northwest and the effects of these formations on hydraulic structures. Discussers are: Jacob Feld, A. Casagrande, A. Mayer, H. Cambefort, Hyde Forbes, L. F. Harza, and Allen S. Cary. (Available October 1.)

D-33. Discussion of Paper, **Strength of I Beams in Combined Bending and Torsion,** by Basil Sourochnikoff. The original paper, published in September 1950, analyzed the stresses in beams due to the interaction of bending and torsion and the influence of de-

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flections on stresses and established allowable stress formulas. Discussers are: Jacob Karol, Melvin W. Jackson, and Basil Sourochnikoff. (Available October 1.)

First Notice

90. Consumptive Use of Water by Forest and Range Vegetation, by L. R. Rich. Consumptive use of water by forest and range vegetation depends on the distribution and occurrence of precipitation, the amount of water held by the soil, and the character and type of vegetation. Under natural conditions, consumptive use can be determined by dividing the year into four periods: (1) soil moisture recharge, (2) water surplus, (3) soil moisture utilization, and (4) water deficit. The major problem in maintaining and increasing irrigation water for the West is to determine the type of vegetation that interferes least with water yields and still controls erosion and sediment. In the Southwest perennial grasses interfere least with water yields and are a better soil cover, while half-shrubs, winter annuals, and evergreen shrubs (all characteristic of deteriorated watershed vegetation) tend to reduce water yields. (Available November 1.)

91. Consumptive Use of Water, by Harry F. Blaney. In water-supply and irrigation investigations, engineers are called upon to make, within a limited time, estimates of probable past, present, and future evaporation and evapo-transpiration losses from areas in river valleys when few long-period hydrologic records, except climatological data, are available. Although evapo-transpiration has been measured at various times and places, very little data are available in most sections of the United States. This paper presents data on measured evapo-transpiration by agricultural crops and natural vegetations and discusses the subject of consumptive use of water with special reference to definitions, method, and results of research by the Division of Irrigation and Water Conservation, United States Soil Conservation Service, and other agencies. It outlines a procedure developed for computing consumptive use in areas which no measurements except climatological data are available. (Available November 1.)

92. Experimental Investigation of Fire Monitors and Nozzles, by Hunter Rouse, J. W. Howe, and D. E. Metzler. The inefficiency of fire streams is directly attributable to the initial turbulence of the free jet. This paper describes the design of a fixed monitor, a portable monitor, and a nozzle that will reduce flow turbulence to a practicable minimum. The underlying design principles are discussed and the efficiencies of existing and improved units—as determined in special testing facilities—are compared. Design details and performance curves are presented for the recommended forms. (Available November 1.)

93. Aircraft Design as Related to Airport Standards, by Milton W. Arnold. Attainment of all-weather operation, utilizing existing aircraft, present-day airports, and presently developed electronic equipment has been found to be economically prohibitive. Closer correlation should exist between aircraft design, airport design, and electronic equipment development to achieve the all-weather goal, at reasonable cost, for the convenience of the flying public. Steps toward the achievement of this goal are outlined in this paper. (Available November 1.)

94. Friendship International Airport, by Benjamin Everett Beavin. An interesting feature of the design of Friendship International Airport was the laying aside of existing (1946) notions as to airport design and going back for guidance to the fundamental needs of the various users, such as the airlines, the taxpayers, government agencies, contractors, and the most important of all, the passengers and prospective passengers. In this paper the total length of apron frontage is shown as a measure of the value received for the money spent in building an airport. The economy of construction and operation is stressed, and many desirable features of design are enumerated. (Available November 1.)

95. Directional Requirements for Airport Runways, by Ralph H. Burke and Harry Otis Wright, Jr. The benefits of airport standards are enumerated in this paper, and the reasons for their adoption are cited. It traces the history of the developments in landing gear and summarizes the effect of these developments on increased tolerance in cross wind operations. Airport utilization with simplified runway patterns is discussed and suggestions are given as to airport design to meet present and future requirements of aviation. (Available November 1.)

96. Surface Curves for Steady Nonuniform Flow, by Robert B. Jansen. A rapid method of determining the water surface curve for steady, varied flow in a prismatic open channel is presented. The described procedure involves a simplified calculation of the stream slopes at intervals along the conduit and a successive plotting of the defined tangents. The special cases of trapezoidal and rectangular sections are treated and equations are developed that are reduced to elementary terms. Representative examples are solved by the suggested procedure, and the curves thus obtained are compared graphically with surface profiles observed or computed by integration of the equation of varied flow. Water depths determined by direct plotting are shown to be sufficiently accurate for design purposes. (Available November 1.)

D-36. Discussion of Paper, **Impossibility of Performance in Contracts for Engineering and Construction,** by Robert F. Borg. The original paper, published in October 1950, examined the problem of determining when an agreement for a project can be excused as impossible of performance. Discussers are: Samuel I. Sacks, Melvin W. Jackson, George J. Soffer, Abraham M. Aloff, and Robert F. Borg. (Available November 1.)

D-39. Discussion of Paper, **Practical Design of Solid-Barrel Reinforced-Concrete Skew Structures,** by Bernard L. Weiner. The original paper, published in October 1950, showed that, with sufficient accuracy for design purposes, the work involved in designing a skew structure may be reduced to little more than that required for a similar right-angle structure. Discussers are: Maurice Barron, Arthur Hayden, and Bernard L. Weiner. (Available November 1.)

D-42. Discussion of Paper, **Wind-Load Standards in Europe,** by John W. T. Van Erp. The original paper, published in November 1950, described the investigation of the exact nature of wind loads on buildings and structures, as conducted in Europe. Discussers are: Paul Rogers, Carl H. Walther, Francis L. Castleman, Jr., and Aron L. Mirsky, S. K. Ghaswala, Herbert S. Saffir, Theodore B. Rights, and John W. T. Van Erp. (Available November 1.)

D-43. Discussion of Paper, **Settlement Correction at La Guardia Field,** by John M. Kyle. The original paper, published in November 1950, reported the sequence of construction operations required to overcome the settlement and flooding of this airport. Discussers are: D. P. Krynine and John M. Kyle. (Available November 1.)

D-44. Discussion of Paper, **The Problem of Wave Action on Earth Slopes,** by Martin A. Mason. The original paper, published in November 1950, discussed the possible application of wartime developments to the knowledge of wave action, particularly in regard to methods of prediction. Discussers are: Robert Y. Hudson, Sr., Fred C. Walker, Henry H. Jewell, C. L. Bretschneider and R. R. Putz, and Martin A. Mason. (Available November 1.)

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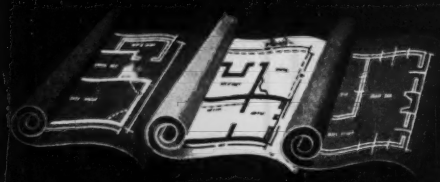

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